computing today

JULY 1980
ISSN 0142-7210
60p

BATTLE OF BRITAIN
Full Simulation Game

KEEPING POSTED- ADDRESS LISTING

MULTIPLE CHOICE EXAM PROGRAM

WOULD YOU MAKE A MONARCH?

THINKING OF BUYING AMERICAN?
See p.18

8K ON BOARD MEMORY!
5K RAM, 3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. System expandable for up to 32K memory.

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56 Key alphanumeric keyboard for entering high level language plus 16 key Hex pad for easy entry of machine code.

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64 character graphics option — includes transistor symbols! Only £18.20 extra!

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high resolution VDU circuitry using discrete TTL for extra flexibility. Has its own 2K memory to give 32 lines for 64 characters.

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low error rate tape interface

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2 MICROPROCESSORS
Z80 the powerful CPU with 158 instruction, including all 78 of the 8080, controls the MM57109 number cruncher. Functions include +, —, *, /, squares, roots, logs, exponentials, trig functions, inverses etc. Range 10^{-99} to 9×10^{99} to 8 figures plus 2 exponent digits.

EFFICIENT OPERATION
Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

RESIDENT BASIC
with extended mathematical capability. Only 2K memory used but more powerful than most 8K Basics!

1K MONITOR
resident in EPROM

SINGLE BOARD DESIGN
Even keyboards and power supply circuitry on the superb quality double sided plated through-hole PCB.

COMPLETE KIT NOW ONLY

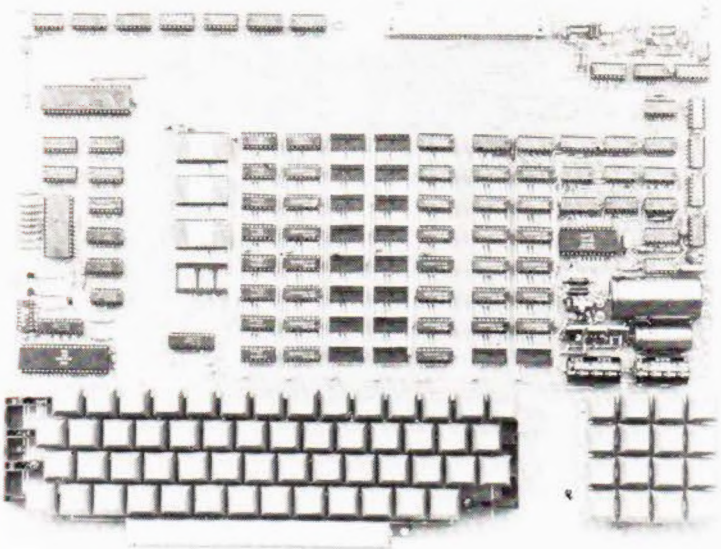
£225 + VAT

POWERTRAN

PSI Comp 80.Z80 Based powerful scientific computer
Design as published in Wireless World

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete!

Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board, 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer, 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.



KIT ALSO AVAILABLE AS SEPARATE PACKS

For those customers who wish to spread their purchase or build a personalised system the kit is available as separate packs eg. PCB (16" x 12.5") **£43.20**. Pair of keyboards **£34.80**. Firmware in EPROMS **£30.00**. Toroidal transformer and power supply components **£17.60**. Cabinet (very rugged, made from steel, really beautifully finished) **£26.50**. P.S. Will greatly enhance any other single board computer including OHIO SUPERBOARD for which it can be readily modified. Other packs listed in our FREE CATALOGUE.

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Expansion up to 32K all inside the computer's own cabinet!

By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computers transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

Mother Board	Fibre glass double sided plated through hole P.C.B. 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug	**£39.90**
8K Static RAM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	**£12.50**
	Set of components including IC sockets, plug and socket but excluding RAMs.	**£11.20**
	Complete set of board, components, 16 RAMS	**£89.50**
8K ROM Board	Fibre glass double sided plated through hole P.C.B. 5.6" x 4.8"	**£12.40**
	Set of components including IC sockets, plug and socket but excluding ROMs	**£10.70**
	2708 ROM (8 required)	**£8.00**
	Complete set of board, components, 8 ROMs	**£78.50**

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JULY 1980

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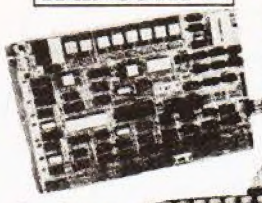
nascom-2 MICRO-COMPUTER



FREE 16k RAM Board
NEW IMPROVED RAM B

only £335 + VAT
immediate delivery

Z80A 8 bit. This will run at 4 Mhz but is selected between 2/4/Mhz.

On-board, addressable memory. 2K
2K Monitor — Nas-sys 1. 1K Video RAM
(MK 4118). 1K work space/User RAM
(MK 4118) (8K Microsoft Basic)
(MK 3600 ROM) (8K Static RAM/2708E)
Power Supply **£29.50 plus VAT**

Microprocessors Z80A. 8 bit CPU. This will run at 4MHz but is selectable between 1/2/4 MHz. This CPU has now been generally accepted as the most powerful, 8 bit processor on the market.

INTERFACE

Keyboard New expanded 57 key Licon solid state keyboard especially built for Nascom. Uses standard Nascom, monitor controlled, decoding.

T.V. The Iv peak to peak video signal can drive a monitor directly and is also fed to the on-board modulator to drive the domestic T.V.

I.O. On-board UART (Int. 6402) which provides serial handling for the on-board cassette interface or the RS232/20mA teletype interface.
The cassette interface is Kansas City standard at either 300 or 1200 baud. There is a link option on the NASCOM-2. For 2400 Baud.
The RS232 and 20mA loop connector will interface directly into any standard teletype.
The input and output sides of the UART are independently switchable between any of the options —
i.e. it is possible to have input on the cassette and output on the printer.

PIO There is also a totally uncommitted Parallel I/O (MK 3881) giving 16, programmable, I/O lines. These are addressable as 2 x 8 bit ports with complete handshake controls.

Documentation Full construction article is provided for those who buy a kit and an extensive software manual is provided for the monitor and Basic.

Basic The Nascom 2 contains a full 8K Microsoft Basic in one Rom chip with additional features like DEEK, DOKE, SET RESET for simple programming.

SYSTEM 80 KITS from £225

Microprocessor board* (Nascom 2)
4MHz Z80 CPU; TV or Video + 1200 baud Kansas City + Serial RS 232 printer Interfaces; Keyboard; 128 character ASCII plus 128 Graphics in 2 x 2K ROM; free 16-way parallel port; 8K BASIC; NAS SYS operating monitor. £280 built and tested.

Firmware & MOS ICs
Zeap Assembler (4, 1Kx8 EPROMS) £50
Nas Pen text editor (2, 1Kx8 EPROMS) £30

Floppy disc system
Double sided, double density 5¼in disc giving 280K bytes formatted, including controller board/PSU/Housing and interconnects £480.
Controller board £127.50 Second Disc £240.
CP/M £80

System 80 housing
High strength GRP moulding
Accepts 12x8 Nascom 2 CPU board, four 8x8 expansion boards. £85 incl. frame racking, interconnects and motherboard.

Expansion boards (in kit form)
16K Ram £127.50 ● 32K RAM £175.00
48K RAM £220.00
High Resolution Programmable Graphics £90
Colour Board Kit £140
High Resolution Colour add on £37.50

All prices subject to VAT. Add 15%.

No more slaving over a hot soldering iron the Nascom 1 is now supplied BUILT!
Britain's biggest small system is available fully constructed for you to slot into your own housing for the ridiculously low price of £140 plus VAT (kit price still only £125 plus VAT).

nascom-1

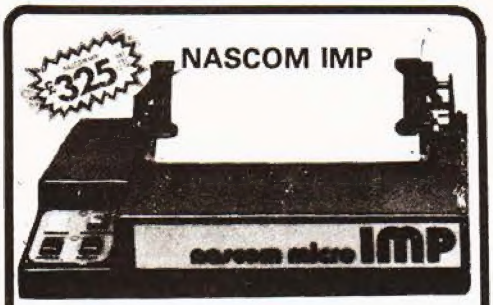
12" x 8" PCB carrying 5LSI MOS packages, 16 1K MOS memory packages and 33 TTL packages.
There is on-board interface for UHF or unmodulated video and cassette or teletype.
The 4K memory block is assigned to the operating system, video display and Eprom option socket, leaving a 1K user RAM.
The MPU is the standard Z80 which is capable of executing 158 instructions including all 8080 code.

NASCOM-1 £125 VAT P&P £1.50

NASCOM PRODUCT LIST + VAT

I/O board kit less I/O chips	45.00
UART + BAUD rate generator + crystal for I/O board	16.00
CTC — MK3882 multiple interrupt driven clock generator for I/O board	8.25
P/IO – MK3881 + interconnect for I/O board	8.50
P/IO interconnect only (for I/O board)	3.80
Econographics kit for additional 128 characters (N1 only)	30.00
2708/2716 Programmer suitable for N1 and N2 under NAS-SYS	£20.95 plus VAT
Nascom 19" rack mounting card frame for N1 and N2	32.50
Nas-DA disassembler 3 EPROM for Nas-sys	37.50
MK36271 8K BASIC in 8K x 8 ROM	40.00
Naspen VS in 2 EPROM	30.00
Nas-sys monitor in 2 EPROM	25.00
Nasbug T2 1 x EPROM	12.50
Nasbug T4 2 x EPROM	25.00
Tiny Basic 2 x EPROM	25.00
Super Tiny Basic 3 x EPROM	37.50
Super Tiny Basic upgrade 1 x EPROM	12.50
Tape Software	
ZEAP 1.2 tape and documentation for N1	30.00
ZEAP 2 tape and documentation for Nas-sys	30.00
8K BASIC tape and documentation for N1	15.00
MEMORIES Discounts 10% for 4, 15% for 8, 20% for 16	
MK3880 (Z80) for N1	7.50
MK3880-N4 (Z80A) for N2	7.95
MK4116 16K x 1 dynamic RAM	7.50
MK4027 4K x 1 dynamic RAM	2.25
2102 1K x 1 static RAM	1.00
4118 1 K x 8 static RAM	12.75
Unprogrammed 2708	7.50
Unprogrammed 2716	19.95
IM6402 UART	4.50
2114 1K x 4 Static RAM	3.95
8080A	5.25

NASCOM IMP



PLAIN PAPER PRINTER Fully built and housed in a stylish enclosure

for just **£325** plus VAT. Interfaces with all micro computers

The Nascom IMP (Impact Matrix Printer) features are

● 60 lines per minute. 80 characters per line. ● Bi-directional printing. ● 10 line print buffer. ● Automatic CR/LF. ● 96 character ASCII set (including upper/lower case, $, £). ● Accepts 8½" paper (pressure feed). ● Accepts 9½" paper (tractor feed). ● Tractor/pressure feed. Baud rate from 110 to 9600. ● External signal for optional synchronisation of baud rate.

IDEAL FOR WORD PROCESSING

COMPUTER KEYBOARDS

TASA 56 key touch sensitive keyboard. All ASCII characters including control keys. Parallel output with strobe. Shift lock. Keys coded in 3 colours to indicate function. 18 V DC at 35 mA. 15" x 6.25" x 0.385" thick. Black resin encapsulated.
49.50 + VAT

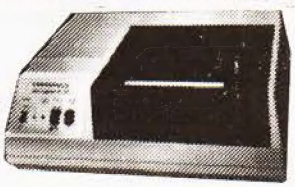
STAR DEVICES MK III 71 keytouch sensitive keyboard. With numeric pad. All ASCII characters including control keys. Auto key repeat. Parallel output with strobe. Shift lock with indicator LED. Built in 'beeper' with level control. 5V DC at 300mA 15" x 7" x 1.25". Grey case with white keys on blue.
48.50 plus VAT

CARTER 57 key ASCII keyboard. Conventional key board. 128 ASCII characters including control keys. Parallel output with strobe. Shift lock. + 5 V and —12 V DC. 12" x 5.5" x 1.5". Black keys with white ledgends.
39.34 + VAT.

FERRANTI – "SIZE 14 x 6 x 3" SLOPING FRONT" 55 Key ASCII Coded in steel case. Complete with Plug and Cable with circuit to convert to T.T.L. levels.
In good condition at only **£25** + VAT, P/P £2.50

CENTRONICS QUICK PRINTER

List Price **£459** incl. VAT



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●Centronics parallel data interface for Nascom, Tandy, etc.
●240 volt mains input. ASCII character set
Paper feed, and on/off select switches
'BELL' signal Weight 10lbs
Size: 13" x 10½" x 4½".
New, boxed and fully guaranteed

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See *COMPUTING TODAY* Recommendations MARCH/MAY ISSUES

TANGERINE COMPUTER SYSTEMS

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Microtan 65 Kit, Incl. VAT	£79.35	Lower case pack, Incl. VAT	£10.90
Microtan 65 Assembled, Incl. VAT	£90.85	Chunky Graphics Pack, Incl. VAT	£7.50
Tanex (min. con) Kit, Incl. VAT	£49.45	20 Way Keypad Incl. VAT	£11.50
Tanex Assembled Incl. VAT	£60.95	Mini-mother board Incl. VAT	£9.95
		Complete Tangerine range available	

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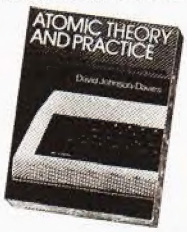
Also available ready-built **£150** plus VAT and p&p

The ATOM – a definitive personal computer. Simple-to-build, simple-to-operate. But a really powerful full-facility computer. And designed on an expandable basis. You can buy a superb expanded package now – tailored to your needs. Or, you can buy just the standard Atom kit, and, as you grow in confidence and knowledge, add more chips. No need to replace your equipment. No need to worry that your investment will be overtaken by new technology. As you need more power, more facilities, you can add them!

*The picture shown demonstrates mixed graphics and characters in three shades of grey provided by the Standard Atom.

The standard ATOM kit includes:

● Full sized QWERTY keyboard ● Rugged polystyrene case ● Fibreglass PCB ● 2K RAM ● 8K ROM ● 23 integrated circuits ● Full assembly instructions including tests for fault-finding. (Once built, connect it to any domestic TV and power source) ● Power requirement: 8V at 800 M A. ATOM power unit available. See coupon. PLUS FREE MANUAL written in two sections – teach yourself BASIC and machine code for those with no knowledge of computers, and a reference section giving a complete description of the ATOM's facilities. All sections are fully illustrated with example programs.



The ATOM concept

Adding chips into sockets on the PCB allows you to progress in affordable steps to large-scale expansion. You can see from the specifications that the RAM can be increased to 12K allowing high resolution (256 x 192) graphics. Two further ROM chips, e.g. maths functions, can be added directly to the board giving a 16K capacity. In addition to 5 I/O lines partly used by the cassette interface, an optional VIA device can provide varied I/O and timer functions and via a buffer device allow direct printer drive. An optional module provides red, green and blue signals for colour. An in-board connector strip takes the ATOM communications loop interface. Any number of ATOMs may be linked to each other – or to a master system with mass storage/hard copy facility. Interface with other ACORN cards is simplicity itself. Any one ACORN card may be fitted internally.

So you can see there are a vast number of modular options and additions available, expanding with your ability and your budget.

The ATOM hardware includes:

● Memory from 2K to 12K RAM on board (up to 35K in case) ● 8K to 16K ROM (two 4K additions) ● 6502 processor ● Video Display allows high resolution (256 x 192) graphics and red, green and blue output ● Cassette Interface – CUTS 300 baud ● Loudspeaker allows tone generation of any frequency ● Channel 36 UHF Modulator Output ● Bus output includes internal connections for Acorn Eurocard.

The ATOM software includes:

● 32-bit arithmetic (±2,000,000,000) ● High speed execution ● 43 standard/extended BASIC commands ● Variable length strings (up to 256 characters) ● String manipulation functions ● 27 32-bit integer variables ● 27 additional arrays ● random number function ● PUT and GET byte ● WAIT command for timing ● DO-UNTIL construction ● Logical operators (AND, OR, EX-OR) ● LINK to machine-code routines ● PLOT DRAW and MOVE.

ACORN COMPUTER

4a Market Hill, CAMBRIDGE CB2 3NJ

Your ACORN ATOM may qualify as a business expense. To order complete the coupon below and post to Acorn Computer for delivery within 28 days. Return as received within 14 days for full money refund if not completely satisfied. **All components are guaranteed with full service/repair facility available.**

Please send me the following items:

Quantity	Item		Item price inc. VAT+p&p	TOTALS
	ATOM KIT 8K + 2K (MIN)		@ £140.00	
	ATOM ASS 8K + 2K (MIN)		@ £174.50	
	ATOM KIT 12 + 12K (MAX)		@ £255.00	
	ATOM ASS 12 + 12K (MAX)		@ £289.50	
	1K RAM SETS		@ £11.22	
	4K FLOATING POINT ROM		@ £23.30	
	PRINTER DRIVE	6522 VIA	@ £10.35	
		LS 244 Buffer (pair)	@ £3.17	
	MAINS POWER SUPPLY (1.5 amps)		@ £10.20	
			TOTAL	

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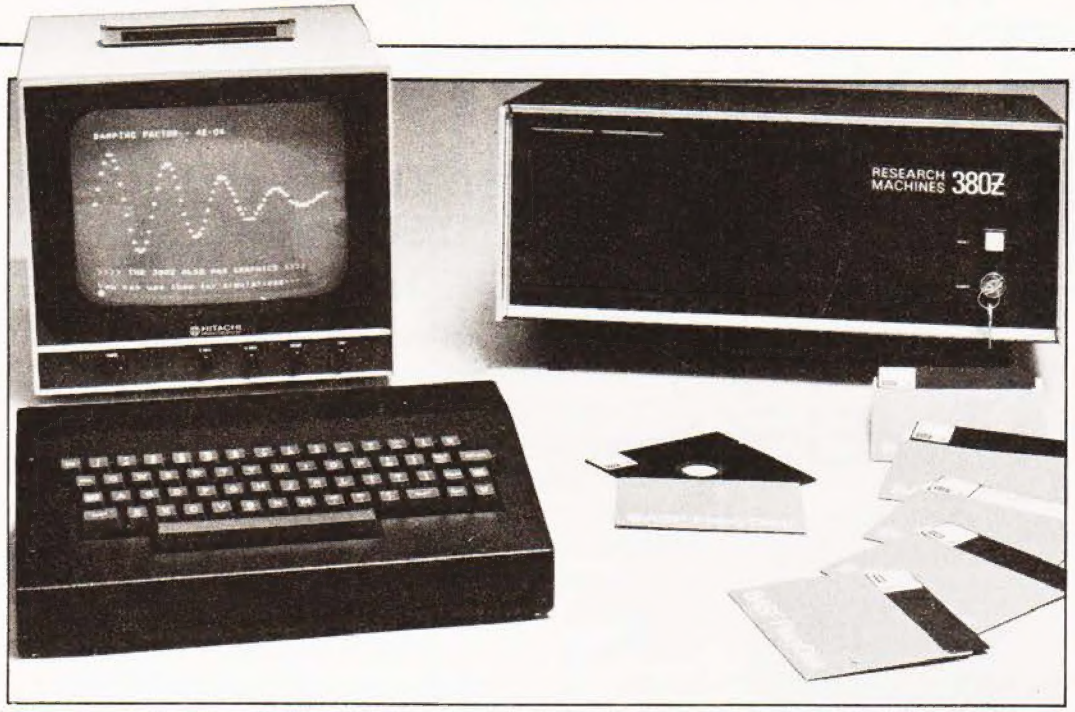


MICRO COMPETITION

As revealed in last months Computing Today the Department of Industry are holding a competition for secondary schools with 100 Research Machines 38OZ computers as prizes. For the top three entries there are complete systems. The means of entry are simple, just write an essay on what your school would do with its prize, your Headmaster should have all the details. The DOI hope that the number of systems will increase as local industry sponsor those schools who did well but didn't collect a prize. It is interesting to note that out of the £9 million that the Department of Education has put forward for "Micro Education" little if any is to be allocated to purchase hardware! People wanting to equip their schools will presumably have to resort to the DOI competition or approach PTAs, etc.

APPLE CASHES IN

One of the many recent software packages to appear for the Apple system is one called Cashier from Oval Computer Systems of Worthing. Not a simulation of the Courts Martial but a set of transaction handlers that are suited to companies selling to the public or other businesses that need detailed tax records. The system stores the customer records and is able to handle stock control and a number of other common functions in addition to its primary invoicing tasks. Main areas of use would be in shops that have a turnover in high value single items, such as computer stores! For more details on the package contact Oval at Elm Park, Ferring, Worthing, West Sussex BN12 5RN or ring on 0903-44831.

MORE AIM EXTRAS

Yet more bolt on extras for the AIM 65 have been announced by Pelco. These include the TV interface designed by our Fruity Friends, Tangerine, which plugs directly into the Expansion Connector and gives a 16 by 40 display. The cost is a mere £69.00 and options of lower case and chunky graphics are also available. Further to the cause is a 4K RAM board for £75, an added chunk of Firmware in the form of a Utilities package and a new monitor. For more details on any of these new products contact Pelco at Regency Square House, Regency Square, Brighton, Sussex BN1 2FH. Their telephone number is Brighton (0273) 722155 for people in a hurry.

PLEASE STOP

Hang on a minute, whoa there, stop! We are still being inundated with reader survey forms and, as some of you may have noticed, we can't send you a replacement issue because we've run out. Those of you who are still sending in survey forms with contents pages will, unfortunately, have to make do with a May issue instead. And whilst we are on the subject of inundation please desist from sending BASIC versions of our Stock market, you have already broken the back of two postmen who tried to carry the mail up to our office. All copies received will be acknowledged but please stop sending them in, we don't know what to do with them all.

MULTI MICRO

New in the small business line from Microsense, the Apple people, is a multi-user system called Microstar. Manufactured by the Micro V Corporation of California it is a three level machine. This means that with three remote terminals three different jobs can be done at the same time, transparently to the users. There are a variety of software packages available; Sales, Purchasing and general Ledgers, Stock Control and Payroll being among the first along with a word processing package. The basic system starts at around £4800 and the expected cost for a complete system is less than £9500. For more information contact Microsense at Maxted Road, Maylands Avenue, Hemel Hempstead, Herts HP2 7LE or ring on 0442-63561.

FRUIT BASKET

Users of the Microtan 65 computer in the Dorset area can now join a club if they so wish. Called TUG, Tangerine Users Group, it has been set up by Bob Green of 3-22 Donoughmore Road, Boscombe, Bournemouth, Dorset and any prospective members should contact him at that address. Tangerine themselves are willing to support any user groups and assist but will take no control, an attitude that some manufacturers would do well to follow.

TOOLS FOR THE JOB

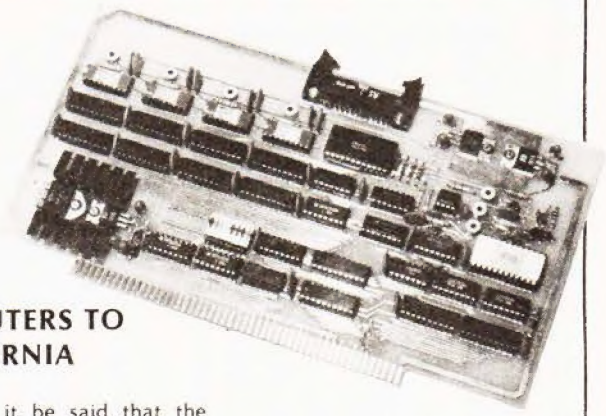
Bits And PCs, the Nascom add-on specialists have just launched a TOOL KIT for use with the 8K Microsoft BASIC. It adds many useful and often needs functions including: Auto line numbering, Block deletion, Renumbering, Hex to Decimal conversion, Single stepping and Variable dump. These, along with the others, reside in two 2708 EPROMs and cost £42 inclusive. Judging by the response to Petsofts original version for the PET sales should be brisk, once you've used one you'll wonder how you ever managed without one.

SUMMER COURSES

The University of Salford is running a three day course in Computer Aided Classroom Instruction from 15 to 17 July. The cost is £27 and the aims are to show how computers can be used in teaching science subjects. For details contact The Administrative Assistant (Short Course), Room 110, Registrar's Department, University of Salford, Salford M5 4WT. Also running this summer is the annual Worcester College of Higher Education Summer School. Two sessions of note here, a practical course on Micro electronics and Micro computers costing £39 and running from 25th July to August 1st and a course on Using Micro computers which also costs £39 and runs from 1st August to the 8th. Applications for these and details of the residential arrangements should be made to the Director of Summer School, Worcester College of Higher Education, Warwick Grove, Worcester WR2 6AJ. Applications should enclose a £5 registration fee which cannot be returned after 7th July. The phone number of the college is 0905-422131.

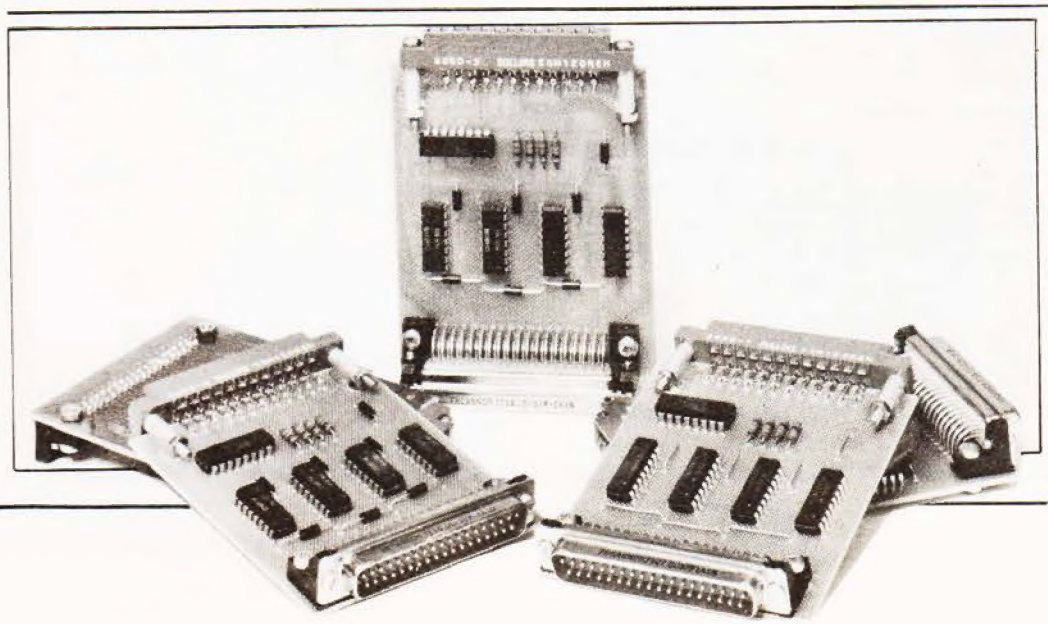
MICRO BRAINED

Launched last week to a chorus of Ooohs and Aaahs was a new and impressive looking micro from Newbury, the terminal people. The machine, called New Brain, is an exceptional piece of hardware. It consists of a full QWERTY keyboard (small keys but standard layout), a Z80 CPU, 2K static RAM which is expandable to 4K or 16K dynamic and a 16K Compiling BASIC. The machine is equipped with more I/O than seen before, it has; full modem V24/RS232, parallel I/O, analogue I/O, video out, two cassette interfaces at 1200 Baud, and a bus port. The system will work as either a handheld BASIC computer for the businessman, engineer or home enthusiast (there are three models) or it will act as a complete remote computer terminal. The internals are all battery powered, the keyboard and single line display are handled by a special COPS chip from National and the Z80 is only powered up when the BASIC is actually running a program. Sales will start in August/September and if you are thinking about a briefcase computer the price may well make you wait because the most expensive in the range is only £249. The "home" model at £159 is not equipped with the one line display system, you are expected to drive a TV or monitor instead but at that price who cares. The machines we tried out at the launch were only preproduction models so full tests on the system were not possible but a machine is currently under evaluation and we will bring you a review as soon as possible. For people in a hurry to get information contact Newbury at King Street, Odiham, Hampshire or the Newbear Computing Street at 40 Bartholomew Street, Newbury, Berkshire.



COMPUTERS TO CALIFORNIA

Never let it be said that the British lack ingenuity. In true tradition a Hertfordshire based firm, Sands-Whitely, are flogging bits of computers back to the Americans. The US firm of Base 2 are buying an A to D card designed around the S100 bus (another American invention) to be installed in computers for process control. The card handles 16 channels of analogue input and four of analogue output. The catch in the situation is that Base 2 are now sending us their low cost matrix printer through Intelligent Artefacts, a subsidiary of Sands Whitley.



BOARD PET?

If your PET is bored with everyday information try feeding it with BCD via this new interface from Amplicon. Designed to allow the PET to monitor such exotic peripherals as DPMs it caters for 3½ digits of BCD plus a two digit indent. Included with the interface are test programs, plug and the necessary documentation to allow you to hook-up your test gear. Cost is £65 plus the everpresent VAT. Contact can be made with Amplicon at 143c Ditchling Road, Brighton, East Sussex or ring 0273-562163.

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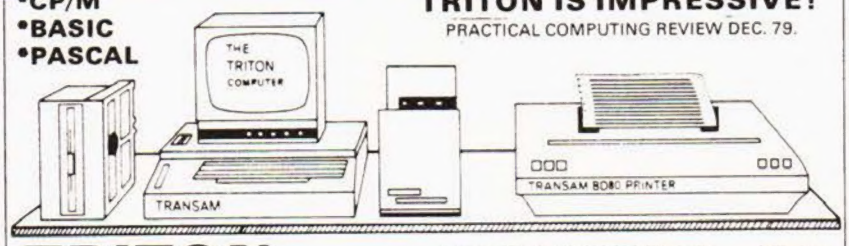
COMPONENTS AND SYSTEMS FROM TRANSAM COMPUTERS

•CP/M
•BASIC
•PASCAL

TRITON IS IMPRESSIVE!
PRACTICAL COMPUTING REVIEW DEC. 79.



TRITON
COMPUTER SYSTEM.

Designed for ease of construction and flexibility. Kits come complete and all components and software are available separately. UK designed and supported. Fully documented hardware and software and a totally flexible approach to system building. Powerful and easy to use system monitors – a range of languages available. Firmware is Eprom based and upgrading from one level to the next is easy.

•L5.2 with 1.5k monitor 2.5k basic	£294.00
•L7.2 with 2k mon 8k extended basic	£409.00
•L8.2 4k ed/mon 20k res pascal	£611.00
•L9.2 CP/M disc based system	P.A.O.
•8k ram card kit (21141)	£97.00
•8k eprom cards (EXCL 8 x 2708)	£31.00
•Motherboard expansion 8 slot	£50.000
•Trap-res assm/edit, etc. (8 x 2708)	£80.00
•Transam BD80 bi-dir printer	£595.00
•TVM 10 video monitor 9"	£79.00
•Eprom prog (2708) kit	£29.50

SEND FOR OUR CATALOGUE FOR FULL DETAILS OF TRITON FEATURES!

CP/M AVAILABLE NOW FOR TRITON

Disc operating system complete with text editor, assembler, debugger, system utilities and complete file management. Makes Triton fully CP/M compatible and able to run CP/M based software. Triton will support up to four 5¼ or 8" drives single or double density full CP/M software user group facilities available. SAE for details.

CP/M Disk plus manuals (6) £75.00

DISK DRIVES & POWER SUPPLIES

SHUGART

SA400 5¼" drive	£205.00
SA800 8" drive	£380.00
Power one quality power supplies	
CP249 1 - 5¼ PSU	£33.00
CP323 2 - 5¼ PSU	£60.00
CP205 1 - 8" PSU	£56.00
CP206 2 - 8" PSU	£76.00

TCL PASCAL – CP/M compatible

A standard Pascal compiler available on a resident (20k) Eprom based configuration* or available to run under CP/M on 8" disc plus documentation. CP/M version £120
*P.O.A.
TCL Pascal Manual and specification £6.50

DIL PLUG SOCKETS & SWITCHES

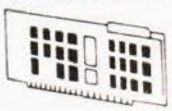
W/WRAP SKTS		DIL SKTS		DIL PLUGS		DIL SWITCHES	
8DIL	0.20	8DIL	0.14	14DIL	0.60	4DIL	1.20
14DIL	0.35	14DIL	0.15	16DIL	0.65	7DIL	1.75
16DIL	0.42	16DIL	0.17	SCOTCHFLEX		8DIL	1.80
18DIL	0.60	18DIL	0.24	14DIL	1.30	16w ZIF*	4.95
24DIL	0.52	20DIL	0.27	16DIL	1.50	24w ZIF*	6.20
28DIL	0.74	24DIL	0.30	24DIL	2.80		
40DIL	0.95	28DIL	0.35				
		40DIL	0.50				

ZERO INSERTION FORCE

FULL RANGE OF MICRO SUPPORT CHIPS – IN STOCK

SN74LS00N	22	SN74LS54N	21	SN74LS138N	95	SN74LS195AN	.85	SN74LS325N	2.55	SUPPORT		RAMS	
SN74LS01N	22	SN74LS55N	21	SN74LS139N	95	SN74LS196N	1.20	SN74LS326N	2.55	8212	2.20	2101	2.32
SN74LS02N	26	SN74LS63N	1.50	SN74LS145N	1.20	SN74LS197N	1.20	SN74LS327N	2.55	8216	2.80	2102L4	1.20
SN74LS03N	26	SN74LS73N	35	SN74LS148N	1.75	SN74LS221N	1.25	SN74LS352N	1.35	8224	2.80	2111	2.32
SN74LS04N	26	SN74LS74N	40	SN74LS151N	85	SN74LS240N	2.20	SN74LS353N	1.50	3853 (F8)	10.00	2112	2.46
SN74LS05N	26	SN74LS75N	48	SN74LS153N	80	SN74LS241N	1.90	SN74LS365N	65	8228	4.20	6810	4.00
SN74LS08N	20	SN74LS76N	35	SN74LS154N	1.60	SN74LS242N	1.90	SN74LS366N	65	8T26A	1.75	8154	11.50
SN74LS09N	22	SN74LS78N	35	SN74LS155N	1.25	SN74LS243N	1.95	SN74LS367N	65	8T28	1.90	2114L 450	5.50
SN74LS10N	18	SN74LS83AN	1.15	SN74LS156N	1.25	SN74LS244N	2.10	SN74LS368N	65	6522	8.75	2114L 250	7.60
SN74LS11N	26	SN74LS85N	1.10	SN74LS157N	80	SN74LS245N	3.60	SN74LS373N	1.75	8251	5.00	74C920	11.00
SN74LS12N	25	SN74LS86N	40	SN74LS158N	99	SN74LS247N	1.25	SN74LS374N	1.70	8253	11.00	74C921	11.00
SN74LS13N	55	SN74LS90N	65	SN74LS160N	1.15	SN74LS248N	1.95	SN74LS375N	72	8255	5.00	74C929	11.00
SN74LS14N	89	SN74LS91N	99	SN74LS161N	1.15	SN74LS249N	1.30	SN74LS377N	1.75	8257	£11.00	4027	5.00
SN74LS15N	25	SN74LS92N	90	SN74LS162N	1.15	SN74LS251N	1.45	SN74LS378N	1.32	8259	12.50	4044	7.00
SN74LS20N	20	SN74LS93BN	65	SN74LS163N	90	SN74LS253N	1.25	SN74LS379N	1.40	8155	12.50	4045	7.00
SN74LS21N	26	SN74LS95AN	1.20	SN74LS164N	1.50	SN74LS257N	1.40	SN74LS381N	3.65	6402	5.00	4060	7.00
SN74LS22N	26	SN74LS96N	1.75	SN74LS165N	1.70	SN74LS258N	95	SN74LS386N	57	6821P	4.50	2107	7.80
SN74LS26N	29	SN74LS107N	39	SN74LS166N	1.75	SN74LS259N	1.45	SN74LS390N	1.98	6850P	4.60	4116/58 for 8	8.00
SN74LS27N	35	SN74LS109N	39	SN74LS168N	1.95	SN74LS260N	39	SN74LS393N	1.50	6852P	5.50	4118	20.00
SN74LS28N	35	SN74LS112N	39	SN74LS169N	1.95	SN74LS261N	3.50	SN74LS395N	1.80	AY 5.2376	11.50	Z80P10	8.00
SN74LS30N	25	SN74LS113N	44	SN74LS170N	2.50	SN74LS266N	39	SN74LS396N	1.70	MC14411	12.00	Z80CTC	8.00
SN74LS32N	27	SN74LS114N	44	SN74LS173N	2.20	SN74LS273N	1.85	SN74LS398N	2.75	M57109	12.43	Z80AP10	9.50
SN74LS33N	39	SN74LS122N	79	SN74LS174N	1.15	SN74LS279N	79	SN74LS399N	1.60	M57160	10.00	Z80ACTC	9.50
SN74LS37N	29	SN74LS123N	90	SN74LS175N	1.05	SN74LS280N	1.75	SN74LS424N	4.50	M57161	10.00	EPROMS	
SN74LS38N	29	SN74LS124N	1.50	SN74LS181N	2.75	SN74LS283N	1.80	SN74LS445N	1.25	TMS6011	5.00	1702	5.00
SN74LS40N	25	SN74LS125N	65	SN74LS190N	1.75	SN74LS290N	1.80	SN74LS447N	1.25	81LS95	1.80	5204	5.00
SN74LS42N	79	SN74LS126N	65	SN74LS191N	1.75	SN74LS293N	1.80	SN74LS490N	1.95	81LS96	1.80	2708	8.00
SN74LS47N	95	SN74LS132N	75	SN74LS192N	1.45	SN74LS295AN	2.20	SN74LS668N	95	81LS97	1.80	2516	25.00
SN74LS48N	95	SN74LS133N	39	SN74LS193N	1.75	SN74LS298N	2.20	SN74LS669N	95	81LS98	1.80	2532	50.00
SN74LS49N	1.09	SN74LS136N	40	SN74LS194AN	1.89	SN74LS324N	1.80	SN74LS670N	2.70				

DOUBLE DENSITY S100 DISK CONTROLLER



Suitable for Triton, DPS-1, etc. Built and tested will drive Shugart compatible 8" or 5¼". Drives single or double sided. Uses the 1791 chip and CPU independent crystal.
Manual **50p** plus SAE.
Board **£195.00** plus VAT

DPS.1 MAINFRAME – PASCAL SYSTEM

S100 to IEEE spec

Send 50p for our ITHACA catalogue

ITHACA

PASCAL/Z build your own Pascal Micro Development system. IEE-S100 bus system using DPS1 main-frame. Supports K2, ASSEMBLE/Z and PASCAL/Z on 8" disc Complete system **£2910.00**

S100 BOARDS

8k Static RAM board (450ns)	£99.00
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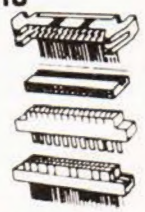
Z80 cpu board (2MHz)	£105.00
Z80 cpu board (4MHz)	£123.00
2708/27 16 EPROM board	£57.00
Prototype board (bare board)	£15.00
Video display board (64 x 16, 128U/L Ascii)	£108.75
Disc controller board	£131.25
K2 disc operating system	£45.00
ASSEMBLE/Z Macro Assm	£37.50
PASCAL/Z compiler	£205.00
PASCAL/Z CP/M	£235.00
16k Static RAM	£275.00

DOUBLE DENSITY CP/M NOW AVAILABLE — CONTACT US FOR DETAILS

MULTIWAY CONNECTORS



INSULATION PIERCING					
20 way plug	2.30	36	72	4.60	
26 way plug	2.70	40	80	5.00	
34 way plug	3.30	43	86	5.50	
50 way plug	4.80	50	100	5.80	
20 way skt	3.40	GOLD 156 PITCH			
26 way skt	4.00	6	12	1.25	
34 way skt	4.80	10	20	1.50	
30 way skt	6.00	12	24	2.00	
EDGE CONN PCB		15	30	2.20	
GOLD .1" PITCH		18	36	2.30	
22/44	3.20	22	44	2.65	
25/50	3.60	28	56	3.30	
28/56	3.90	36	72	3.90	
30/60	4.15	43	86	4.60	64 way DIN male 2.50
					64 way DIN female 4.50

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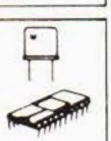
WE ALSO STOCK:– A comprehensive range of books and magazines, VERO products including S100 and Eurocard and Wire Wrap equipment, Weller soldering equipment, Ribbon Cables, tools, tapes, diskettes, connectors and OK Tool range.
Systems continuously on display in our showroom.

CRYSTALS					
100k	3.00	4MHz	2.10	F8 (3850)	9.50
200k	3.70	4.43M	1.00	8080A	6.33
1MHz	3.60	5MHz	2.70	6809	24.00
1008k	3.50	6MHz	2.70	Z80	8.00
1843k	3.00	7MHz	2.70	Z80A	15.00
2MHz	1.50	7.168M	2.50	8085A	12.95
2457k	3.05	8MHz	2.70	6502	8.00
3276k	2.70	10MHz	2.70	SCMP11	10.00
		10.7M	2.70	6802	13.95



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NEW A4 SIZED ONLY 50p & S.A.E.

1980

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1.30-2.30 closed lunch
9.30-5.00 Sat
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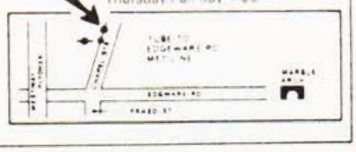
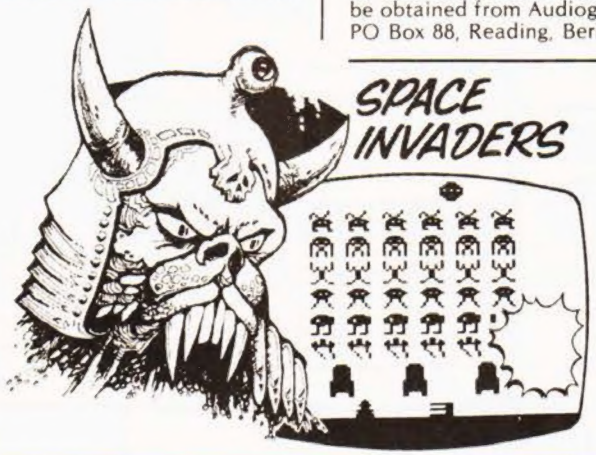


TRANSAM COMPONENTS LTD, 12 CHAPEL STREET, LONDON NW1 **Tel: 01-402 8137 Telex: 444898**

MARKET INVASION

Owners of the Atari Video Computer System have been buying up all the Space Invader cartridges that they can lay hands on. Sales for the first fortnight exceeded the expected sales for six weeks say Ingersoll, the machines UK distributors. Never fear though, extra stocks have been airfreighted in to allow those unfortunates who haven't got one yet to buy. For details of the complete Atari range including the 400, 800 and VCS systems contact Ingersoll Electronics at 202 New North Road, London N1 7BL or ring on 01-226 1200.



COMPUTER FAIR

The North London Hobby Computer Club, in association with the other London computer clubs, has formed The Association of London Computer Clubs which will run its first Computer Fair on July 11th/12th. The venue is the theatre of the Polytechnic of North London, that's opposite the Holloway Road tube. Admission to this, the first true "grass-roots" computer show is 50p unless you are pre-registered. Full details are available from Robin Bradbeer at PNL or the club secretary, Olenka, on 01-607 2789 ex 2445/7.

CRASH SAVER

Owners of the Commodore PET who suffer from crashes can now buy a life-saver.

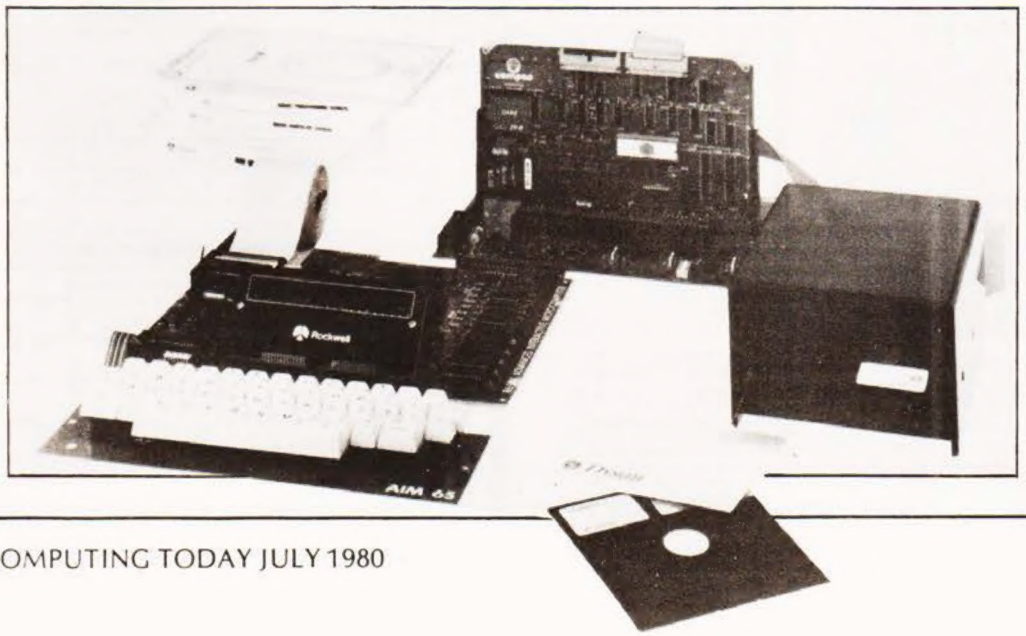
Called PETSET it is a small unit that fixes to the front panel of the machine and connects to the rear edge connectors. Costing a paltry £15.75 it allows the crashed PET owner to recover without loss of stored BASIC programs, it can also be used as a memory clear device without having to resort to the mains switch. Audiogenic also market the PetPack range of software and details of both can be obtained from Audiogenic at PO Box 88, Reading, Berkshire.

ZENITH DEBUG

A slight amount of confusion may have met your eye when you read our review of the Zenith Z89 computer in last month's issue. The machine we reviewed was the Z89, the heading on the second page was a slight case of dyslexia. We have been asked to point out that the system is available in kit form from Heathkit, as opposed to Zenith Data Systems, as the H89 with a single floppy disc and 16K or as the H88 with a cassette interface and 16K. The Z89 is available in 16, 32 or (as we reviewed) 48K versions. If you still can't work it out contact Heathkit at Bristol Road, Gloucester GL2 6EE.

FILE DEVELOPMENT CUT

Most people who are involved in writing commercial software will at some time have to attempt sequential files. When you are attempting to develop systems in BASIC this can be a real headache but there is now a short cut. Using a new package called MAGSAM it is claimed that the time to produce software is dramatically cut. The new package consists of a utility program that uses dynamic allocation of space for files and is easily accessed through the normal BASIC commands, the utility does the rest. Also included is a tutorial program and a 108 page manual full of examples. There are a number of versions for CBASIC, Microsoft or Micropolis at £110 and it is hoped to have a high speed assembler version soon for CBASIC at £210. For further information contact Paul Rayner at Great Northern Computer Services, 116 Low Lane, Horsforth, Leeds LS18 5PX or ring 0532-589980.



AIMING FOR DISCS

AIM 65 users who wish to expand into the floppy dimension can at last reap the benefits with an offering from Portable Microsystems. The new hardware is called DAIM and will give the user two 5¼" mini discs and up to 160K of mass store. The operating system is in ROM on the controller that plugs into the motherboard. Cost of the unit with the controller, power supply and a single drive is £695 + VAT. For those wishing to expand their capabilities Portable Microsystems live at Forby House, 18 Market Place, Brackley, Northants NN13 5SF, or ring on 0280-702017.

interface components

nascom-2

£225 + VAT + P&P £1.50

nascom-1

12" x 8" PCB carrying 5LSI MOS packages, 16 1K MOS memory packages and 33 TTL packages. There is on-board interface for UHF or unmodulated video and cassette or teletype. The 4K memory block is assigned to the operating system, video display and EPROM option socket, leaving a 1K user RAM.

The MPU is the standard Z80 which is capable of executing 158 instructions including all 8080 code. **Built price £140 + VAT.**

NASCOM-1 £125 + VAT + P&P £1.50

MEMORY ● 8K Microsoft BASIC ● 2K NAS-SYS 1 monitor ● 1K Video RAM ● 1K Workspace/User RAM. ● On-board 8 sockets provided for memory expansion using standard 24-pin devices: 2708, 2716, 2732 EPROMS and MK4118 static RAM. **MICROPROCESSOR** ● Z80A which will run at 4MHz but is selectable between 2/4 MHz.

HARDWARE ● Industrial standard 12" x 8" PCB, through hole plated, masked and screen printed. All bus lines are fully buffered on-board.

INTERFACES ● Licon 57 key solid state keyboard ● Monitor/domestic TV interface ● Kansas City cassette interface (300/1200 baud) or RS232/20mA teletype interface.

The Nascom 2 kit is supplied complete with construction article and extensive software manual for the monitor and BASIC.

REVOLUTIONARY TOUCH ACTIVATED KEYBOARD TASA MODEL 55

£49.50 + VAT + £1 P&P

Designed and manufactured by TASA Inc of California, the TASA keyboard is a truly solid state system that has no moving parts and is virtually indestructible. Totally flat and measuring just 0.325" thick, 6.25" deep, 15.05" wide, the TASA has full 128 position 8-bit ASCII output plus continuous strobe, parity select. The touch sensors are sealed in tough polycarbonate which is washable and can withstand rugged treatment in harsh environments.

NEW

Other features include:

- Built-in electronic shift lock.
- Two-key rollover to prevent accidental two-key operation (excluding "control" and "shift").
- Electronic hysteresis for firm "feel".
- Signal activation time of 1 millisecond.
- Output via 12-way edge connector.
- CMOS compatible with pull-up resistor.
- Parallel output: active pull-down, direct TTL compatible (one load) open collector type.

THE MOST FLEXIBLE SYSTEM EVER!

Nascom System 80 – Total Option Concept

Floppy disc system
Double sided, double density 5¼in disc giving 280K bytes formatted including controller board/PSU/Housing and interconnects £480. Controller board £127.50 • Second Disc £240. CP/M £80.

System 80 housing
High strength GRP moulding in variety of colours. Accepts 12x8 Nascom 2 CPU board, four 8x8 expansion boards. £85 incl. frame racking, interconnects and motherboard.

Expansion boards*
16K RAM £140.00 ● 32K RAM £200.00

High Resolution Programmable Graphics £90 (kit)
High Resolution Colour board £140 (kit)

*Available in kit form.
All prices subject to VAT.

Microprocessor board* (Nascom 2)
4MHz Z80 CPU, TV or Video + 1200 baud Kansas City + Serial RS 232 printer interfaces. Keyboard. 128 character ASCII plus 128 Graphics in 2 x 2K ROM, free 16-way parallel port. 8K BASIC. NAS SYS operating monitor. £280 built and tested.

Firmware & MOS ICs
Zeap Assembler (4 1K x 8 EPROMS) £50. Nas Pen text editor (2 1K x 8 EPROMS) £30. NAS-DIS disassembler (3 1K X 8 EPROMS) £37.50 • 2708 £9.50 • 2716 £26. MK 4118N4 £12.75 • MK 4116N4 £55 for 8.

AVAILABLE SOON

NEW

NASCOM FIRMWARE IN EPROM

NASPEN: £25.00 + VAT + 30p P + P
ZEAP 2: £50.00 + VAT + 30p P + P
NAS-SYS 1: £25.00 + VAT + 30p P + P

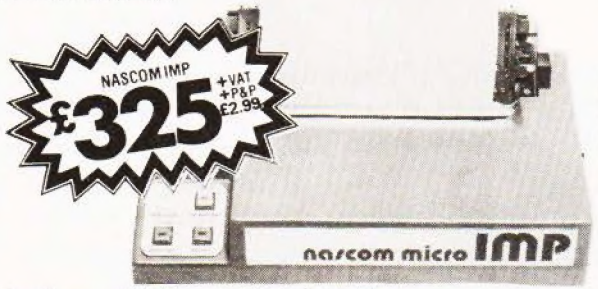
NASCOM SOFTWARE ON TAPE

8K BASIC: £15.00 - VAT
ZEAP 1: £30.00 - VAT - 50p P + P
ZEAP 2: £30.00 - VAT - 50p P + P

NASCOM HARDWARE

Motherboard: £5.50 + VAT + 50p P + P
Mini Motherboard: £2.90 + VAT + 50p P + P
3 amp PSU: £29.50 - VAT + £1.50 P + P
VERO DIP board: £10.50 + VAT + 50p P + P
FRAME: £32.50 - VAT + £2.00 P + P

NASCOM IMP PLAIN PAPER PRINTER



The Nascom IMP (Impact Matrix Printer) features :

● 60 lines per minute ● 80 characters per line ● Bi-directional printing ● 10 line print buffer ● Automatic CR/LF ● 96 characters ASCII set (includes upper/lower case, $, #, £) ● Accepts 8½" paper (pressure feed) ● Accepts 9½" paper (tractor feed) ● Tractor/pressure feed ● Baud rate from 110 to 9600 ● External signal for optional synchronisation of baud rate ● Serial RS232 interface.

MICRO MART

IC SOCKETS	
8 pin	10p each
14 pin	12p each
16 pin	13p each
20 pin	25p each
24 pin	30p each
28 pin	35p each
40 pin	40p each
ICs	
EPROMs 2708	£9.00 each
EPROMs 2716	£26.00 each
MEMORIES	
21L02	£0.80 each
4027	£2.75 each
4116	£7.50 each
2114	£4.00 each
Z80 DEVICES	
MK3880	£12.50 each
MK3881 (PIO)	£7.50 each
MK3882 (CTC)	£7.50 each
VOLTAGE REGULATOR SPECIAL OFFER	
LM309K	90p each

Add VAT and 30p P&P to all orders

VISIT OUR NEW SHOP

We stock PET, TRS 80, Sharp MZ-80K, Atari TV games and extensive range of electronic components including ICs, discrete semiconductors, capacitors, resistors, VERO products, tools and accessories for both professional and amateur constructors.

ORDER FORM

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Tel: 02403 22307. Telex: 837788.

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computing today

What to look for in the August issue on sale July 11th.

GENERAL PURPOSE RECORDS KEEPING PROGRAM

A real 'goody' from one of our best software contributors. Written in BASIC it will allow for creation of files, saving and loading (from backing store), screening page by page of any file contents retreiving, modifying and sorting said files. All with excellent annotation and explanation. Invaluable to small business, school and home alike.

SYSTEMATIC PROGRAMMING

So you think you know how to program? How many redundant lines (and hence bytes of highly expensive RAM) are there in your 'Star Wars' simulation? Unless you have adopted a rigorously logical and SYSTEMATIC approach to your task these will be quite a few. Clean up your RAM and make Britain a tidier place with next months mandatory CT article.

FLOPPY DISCS - THE WHERE, WHEN, HOW AND WHO WITH!

Discs are becoming the standard add-on to any micro-system. Time was when they cost more than a battleship. As prices have fallen the magic spinning memories have sprung up elsewhere. Next month we try to fill the 'information gap' on this vital peripheral by updating your store with all you need to know about discs.

THE 79-09 COMPUTER

Newbears little baby bear. Continuing our highly acclaimed series of hardware reviews we take a good long look at the 79-09. What is it, and how good is it?

PUT SOME COLOUR INTO YOUR NASCOM

There is an add-on available on the market to turn a NASCOM into a full colour-graphics-able system. It comes as a kit and could be the answer to dreams of red screen in the sunset.

M. F. Everitt

We keep you posted with this useful piece of software

Like many others I would class myself as a computer enthusiast, but I'm sure that like many others I flounder along in a sea of hardware and software without too much understanding of what's happening. It is against this background that my colleagues suggested to me that it would be extremely useful to have a program that could handle a mailing list

Like A Fish Out Of Water

And so, still floundering, I set to work to produce the following program in TRS 80 Level II disk BASIC. As a word of encouragement this program also represents my first serious programming attempt!

The facilities offered by the program are as follows:

1) creation of an address list with telephone number and two letter category identification code.
2) access to this list for either a label print or a straight list.
3) selection of category by letter code
4) forward or reverse stepping through file
5) automatic repeat of previously selected function.
6) incorrect input reduced by use of error messages.

File Considerations

The data files have been configured so that the field is dimensioned at 128 bytes, thus giving two subrecords to each physical record. Individual items within this field can be dimensioned to suit individual needs

Some optimisation of the program can be performed by altering the matching performed at line 520. Currently the program checks the input name on the first four letters, this could be reduced to three if the individual lists contain shorter names. Printer status has been built into the program because the author uses a Centronics P1 whose status is 191, the normal value is 233. These values may be altered to suit your requirements in lines 1020 to 1090. The operation of the program does assume that you have the TRS 80 Level II, an expansion interface, a floppy disk and a printer!

Although this programming project started with a few lines that were rapidly added to and modified and may well appear to be a perfect example of confused programming it does actually work and may well be useful for small business, clubs and associations or indeed anyone who has need of a rapid mailing service.

Variables Used

The following list of variables will assist anyone trying to find their way around the insides of the program

MAILING LIST

STRING

GR$ — CATEGORY (G$)
NM$ — NAME (N$)
AD$ — ADDRESS 1 (A$)
SS$ — ADDRESS 2 (S$)
TN$ — TOWN (T$)
CT$ — COUNTY (C$)
PH$ — TELEPHONE (H$)
P$ — HARD COPY ?
I$ — CONTINUING OP. SELECT.
NN$ — SURNAME OR KEY NO..
Q$ — NO. OF ITEMS REQUIRED
E$ — LABELS OR LIST ?
M$ — CATEGORY SELECT

INTEGER

I% — SELECT MODE 0,1,2
D% — LOF INDICATION
Z% — WRITE KEY NO.
K% — MODIFIED KEY NO.
A% — STEP B%
T% — KEY NO. INC OR DEC
P% — PHYSICAL RECORD NO.
S% — SUB RECORD NO.
C% — VAL(NN$)
B% — VAL(Q$)
M% — MESSAGE COUNTS
N% — MESSAGE DELAY COUNT

```
100 REM ADDRESS AND MAILING LIST PROGRAM
110 REM BY MAURICE EVERITT 1980
120 CLEAR 500
130 OPEN"R",1,"MAILS/LST"
140 CLS:PRINT:PRINT:INPUT"TYPE 1<EN> TO
    WRITE, 2<EN> TO READ, 0<EN> TO
    QUIT";I%
150 IFI% =0THENCLOSE:END
160 IFI% >2THEN830
170 IFI% =2THENCLS:PRINT@312,CHR$(23),
    " ":PRINT:GOTO950
180  CLS:A% =0:T% =0:D% =LOF(1):PRINT
    :PRINT:PRINT"LENGTH OF FILE = ";D%
190 INPUT"TYPE KEY NUMBER<EN> OR 0<EN>
    FOR MENU";Z%
200 IFZ% =0 THEN 140
210 K% =Z% +A% +T%
220 IFK% =0THEN140
230 P% =INT((K%-1)/2) +1
240 S% =K%-2*(P%-1)
250 FIELD 1,((S%-1)*127) AS STARTHERE$,2 AS
    GR$,18 AS NM$,25 AS AD$,24 AS SS$,20 AS
    TN$,14 AS CT$,24 AS PH$
260 GET 1,P%
270 IFI% =1THEN300
280 IF K% >(LOF(1)*2) +1 THEN 1100
290 IFI% =2THEN390
300 PRINT"WRITING SUBRECORD #"S%"IN
    PHYSICAL RECORD #"P%
310 PRINT:PRINT"CATEGORY?"TAB(20);:LINE
    INPUTG$:LSET GR$ =G$
320 PRINT"NAME? TAB(20);:LINE INPUT N$:LSET
    NM$ =N$
330 PRINT"ADDRESS-1?"TAB(20);:LINE INPUT
    A$:LSET AD$ =A$
340 PRINT"ADDRESS-2?"TAB(20);:LINE INPUT
    S$:LSET SS$ =S$
350 PRINT"TOWN?"TAB(20);:LINE INPUT T$:LSET
    TN$ =T$
360 PRINT"COUNTY?"TAB(20);:LINE INPUT
    C$:LSET CT$ =C$
370 PRINT"TELEPHONE?"TAB(20);:LINE INPUT
    H$:LSET PH$ =H$:PRINT
380 PUT 1,P%:PRINT:INPUT"PRESS <EN> FOR
    MENU":X:GOTO140
390 PRINT"READING SUBRECORD #"S%"IN
    PHYSICAL RECORD #"P%
400 PRINT:PRINT"KEY NUMBER #";K%
410 PRINT:PRINT"CATEGORY"TAB(20)GR$
420 PRINT"NAME"TAB(20)NM$
430 PRINT"ADDRESS"TAB(20)AD$
440 PRINTTAB(20)SS$
450 PRINT"TOWN"TAB(20)TN$
460 PRINT"COUNTY"TAB(20)CT$
470 PRINT"TELEPHONE"TAB(20)PH$
480 IFLEFT$(L$,1) ="Y"THEN800
490 IFLEFT$(I$,1) ="P"THEN 610
500 IFLEFT$(I$,1) ="X"THEN 610
510 IFK% =VAL(NN$)THEN610
520 IFLEFT$(NN$,4) < >LEFT$(NM$,4)
    THEN T% =T% +1:GOTO 210
530 GOTO610
540 PRINT:PRINT"PRESS 'P' <ENTER> FOR
    PREVIOUS ADDRESS"
550 PRINT"PRESS 'X' <ENTER> FOR NEXT
    ADDRESS --->OR---->"
560 PRINT"PRESS 'N' <ENTER> FOR ANOTHER
    NAME"
570 PRINT:INPUT"PRESS ANY OTHER
    KEY + <ENTER> FOR MENU";$:IFLEFT$(I$,1) =
    "X"THEN860
580 IFLEFT$(I$,1) ="P"THEN910
590 IFLEFT$(I$,1) ="N"THEN170
600 P$ =" ":I$ =" ":GOTO140
610 PRINT:INPUT"DO YOU WANT HARD
    COPY";P$:IFLEFT$(P$,1) < >"Y"THEN540
620 GOSUB1020
630 INPUT"DO YOU WANT MULTIPLE
    LISTING";L$:IFLEFT$(L$,1) ="N"THEN650
640 INPUT"HOW MANY ITEMS";Q$
650 INPUT"LABEL OR LIST";E$
66* IFLEFT$(E$,1) < >"L"THEN990
670 IFLEFT$(L$,1) < >"Y"THEN820
680 INPUT"WHICH CATEGORY?? 'ALL', 'RE',
    'AR'--->";M$
690 IFLEFT$(M$,2) ="RE"THEN920
700 IFLEFT$(M$,2) ="AR"THEN940
710 IFM$ < >"ALL"THEN990
720 IFLEFT$(L$,1) < >"Y"THEN820
730 B% =VAL(Q$)
740 FORA% =0TOB%:IFA% =B%THEN L$ =" ":
    GOTO140
750 CLS:GOTO210
760 LPRINT" ":LPRINTK%;
770 LPRINTTAB(8)NM$:LPRINTTAB(8)AD$:
    LPRINTTAB(8)SS$:LPRINTTAB(8)TN$:
    LPRINTTAB(8)CT$
780 IFLEFT(L$,1) ="N"THEN610
790 NEXTA%
800 IFLEFT$(M$,3) ="ALL"THEN820
810 IFGR$ < >M$THEN860
820 IFLEFT$(E$,2) ="LA"THEN760ELSE870
830 CLS:FORM% =1TO10:PRINT@440,CHR$(23),
    "1,2, OR 0 PLEASE !!!";
840 FORN% =1TO100:NEXT
850 PRINT@440,CHR$(23),"      "FORN% =1TO100:
    NEXT N%, M%:GOTO 140
860 T% =T% +1:GOTO210
870 LPRINT" "
880 LPRINTGR$:K%;NM$:LPRINTTAB(7)AD$:
```

```
    LPRINTTAB(7)SS$:LPRINTTAB(7)TN$:
    LPRINTTAB(7)CT$:" TEL.";PH$
 890 IFLEFT$(L$,1)"N"THEN530
 900 NEXTA%
 910 T% = T%-1:GOTO210
 920 IFLEFT$(GR$,2) = "RE"THEN720
 930 T% = T% + 1:GOTO720
 940 IFLEFT$(GR$,2) = "AR" THEN720ELSE930
 950 INPUT"GIVE SURNAME OR FILE KEY
     NUMBER";NN$
 960 C% = VAL(NN$):IF C% > 0 THEN 980
 970 CLS:Z% = 1:A% = 0:T% = 0:GOTO210
 980 CLS:Z% = C%:A% = 0:T% = 0:GOTO 210
 990 CLS:PRINT@523,"PLEASE INPUT THE
     CORRECT LETTERS"
1000 FORN% = 1TO300:NEXT
1010 GOTO610
1020 R = PEEK(14312)
1030 IFR = 255THENPRINT"PRINTER POWER
     SWITCH IS OFF – SWITCH ON"
1040 R = PEEK(14312)
1050 IFR > 233THEN1040
1060 IFR > 190THENPRINT"PRINTER SELECT
     SWITCH IS OFF – SWITCH ON"
1070 R = PEEK(14312)
1080 IFR > 63THEN1070
1090 PRINT:PRINT"PRINTER READY":RETURN
1100 CLS:PRINT@440,CHR$(23),"END OF FILE
     READ":PRINT:D% = LOF(1):PRINT"LENGTH OF
     FILE = ";D%:FORN% = 1TO2000:NEXT
1110 CLS:GOTO140
```

Fig.1. The program listing for the Mailing List program.

1	ALDERWOOD J H 65 WALTERS ROAD PINDERS END BOURNE BUCKS
2	BLINKWELL T R 89 FELDON ROAD MIDDWICK BRENTFIELD MIDDX
3	CALDER B J 46 AUSSIE STREET EALWOOD LUNFORD MIDDX
4	DOWNTOWN F W 45 HORSEFIELD ROAD BENS END HAMAL HAMPSTEAD HERTS
5	EDWARDS P J 'CEDARS' 34 WESTFIELD GROVE GRANTWOOD LINCS
6	FILKIN D F 89 THE GROVE FINFIELD STANMORE MIDDX

Fig.2. A specimen label printout, this could be on strip labels or on an adhesive backed sheet that is cut up.

AR 12	LANGLEY B G 57 SWINTON LANE WOODBRIDGE HUNTON LANCS Tel. 032-65 67543
RE 13	MOORE D K 21 WILLERBY STREET WILITON SURBITON SURREY Tel. 0232-78654
AR 14	NORMAN K H 61 WILLINGTON PLACE FILTON BRISTOL GLOS TEL. 0532-89732
AR 15	ORTON K W 'EMBERY' 57 THE LIMES WALLINGTON OXON TEL. 832-897345
RE 16	PARTON D NASH VILLAS TENN-R-SEA USARON WOLTS TEL. 202-78621
AR 17	QUIRK A S 'STRANGEWAYS' BRIXTON PATH WORMWOOD GLOS TEL. 352-89328

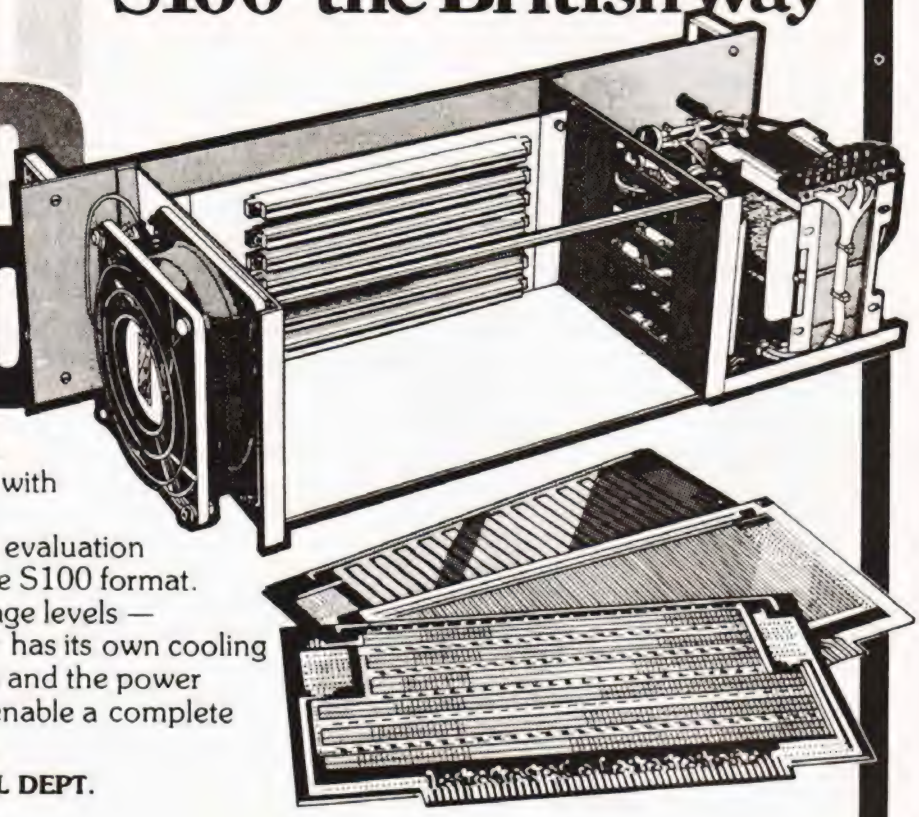
Fig.3. A sample of the "addressbook" type of printout.

```
TYPE 1(EN) TO WRITE, 2(EN) TO READ, 0(EN) TO QUIT?
2

GIVE SURNAME OR FILE KEY NUMBER? 12
READING SUBRECORD #2 IN PHYSICAL RECORD #6

KEY NUMBER #12

CATEGORY          AR
NAME              LANGLEY B G
ADDRESS           57 SWINTON LANE
                  WOODBRIDGE
TOWN              HUNTON
COUNTY            LANCS
TELEPHONE         032-65 67543

DO YOU WANT HARD COPY? NO

PRESS 'P'(ENTER) FOR PREVIOUS ADDRESS
PRESS 'X'(ENTER) FOR NEXT ADDRESS---)OR----)
PRESS 'N'(ENTER) FOR ANOTHER NAME

PRESS ANY OTHER KEY+(ENTER) FOR MENU? N

GIVE SURNAME OR FILE KEY NUMBER? ALDERWOOD
READING SUBRECORD #1 IN PHYSICAL RECORD #1

KEY NUMBER #1

CATEGORY          AR
NAME              ALDERWOOD J H
ADDRESS           65 WALTERS ROAD
                  PINDERS END
TOWN              BOURNE
COUNTY            BUCKS
TELEPHONE         0652-789654

DO YOU WANT HARD COPY? YES
PRINTER SELECT SWITCH IS OFF — SWITCH ON

PRINTER READY
DO YOU WANT MULTIPLE LISTING? YES
HOW MANY ITEMS? 2
LABEL OR LIST? LABEL
WHICH CATEGORY?? 'ALL', 'RE', 'AR'---)? AR
READING SUBRECORD #1 IN PHYSICAL RECORD #1

KEY NUMBER #1

CATEGORY          AR
NAME              ALDERWOOD J H
ADDRESS           65 WALTERS ROAD
                  PINDERS END
TOWN              BOURNE
COUNTY            BUCKS
TELEPHONE         0652-789654

1       ALDERWOOD J H
        65 WALTERS ROAD
        PINDERS END
        BOURNE
        BUCKS

READING SUBRECORD #2 IN PHYSICAL RECORD #1

KEY NUMBER #2

CATEGORY          RE
NAME              BLINKWELL T R
ADDRESS           89 FELDON ROAD
                  MIDDWICK
TOWN              BRENTFIELD
COUNTY            MIDDX
TELEPHONE         01-576-7659
READING SUBRECORD #1 IN PHYSICAL RECORD #2

KEY NUMBER #3

CATEGORY          RE
NAME              CALDER B J
ADDRESS           46 AUSSIE STREET
                  EALWOOD
TOWN              LUNFORD
COUNTY            MIDDX
TELEPHONE         01-999-1212
READING SUBRECORD #2 IN PHYSICAL RECORD #2

KEY NUMBER #4

CATEGORY          RE
NAME              DOWNTOWN F W
ADDRESS           45 HORSEFIELD ROAD
                  BENS END
TOWN              HAMAL HAMPSTEAD
COUNTY            HERTS
TELEPHONE         0442-55587
READING SUBRECORD #1 IN PHYSICAL RECORD #3

KEY NUMBER #5

CATEGORY          AR
NAME              EDWARDS P J
ADDRESS           'CEDARS'
                  34 WESTFIELD GROVE
TOWN              GRANTWOOD
COUNTY            LINCS
TELEPHONE         08976-99878

5       EDWARDS P J
        'CEDARS'
        34 WESTFIELD GROVE
        GRANTWOOD
        LINCS

TYPE 1(EN) TO WRITE, 2(EN) TO READ, 0(EN) TO QUIT?
1

LENGTH OF FILE = 14
TYPE KEY NUMBER(EN) OR 0(EN) FOR MENU? 29
WRITING SUBRECORD #1 IN PHYSICAL RECORD #15

CATEGORY          RE
NAME?             EVERITT M F
ADDRESS-1?        41 GREAT VICTORIA STREET
ADDRESS-2?        BENFIELD
TOWN?             BERKHAMSTEAD
COUNTY?           HERTS
TELEPHONE?        BERKHAMSTEAD 12

PRESS (EN) FOR MENU?

TYPE 1(EN) TO WRITE, 2(EN) TO READ, 0(EN) TO QUIT?
```

Fig.4. A sample run of the program, operator responses are in italic type.

S100-the British way

vero



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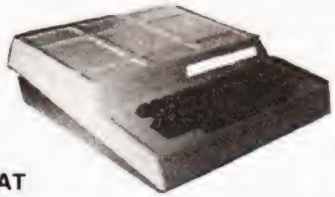

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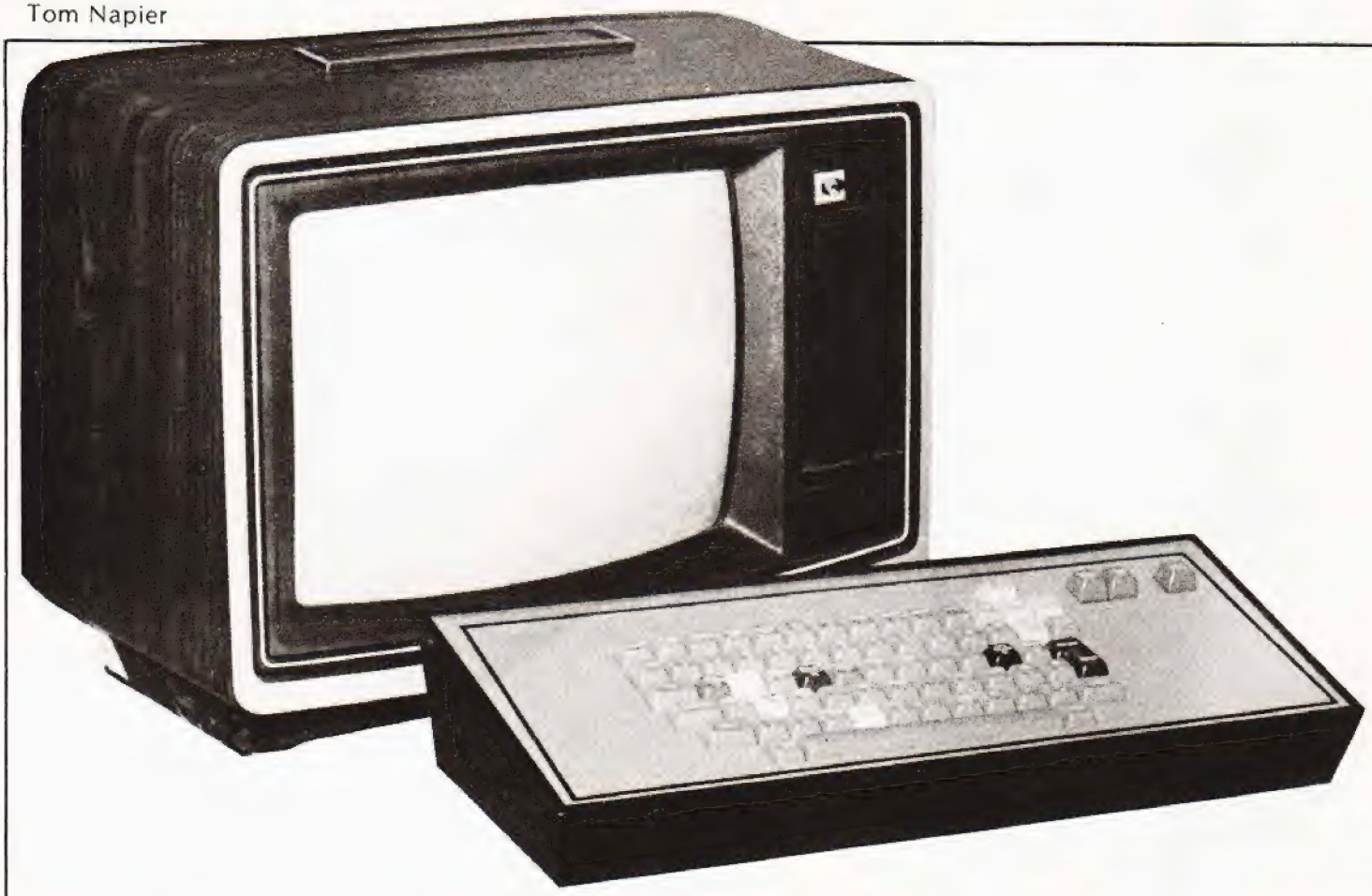


In our continuing series of owners reports we look at the Compucolor II, the colour graphics computer that never seemed to catch on.

My purchase of a personal computer was the culmination of some four years experience with microprocessors and about two years active consideration of which machine to buy. Obviously some of the factors that led me to the Compucolor II will not be relevant to others making their choice of computer but I'll list them to show the considerations I had in mind. One was that I had become totally immersed in the Intel 8080 at work and I had developed a considerable software library for it but I had only a passing acquaintanceship with the other micros. I could see that a Z-80 based system would have some advantages but I was reluctant to buy one of the many systems based on the 6502. Another factor was that I had struggled for years with a microcomputer using a fairly sophisticated cassette system; if there was any way that I could have a disk drive for a reasonable price I would have it! Lastly, the chief advantage of the microcomputer over the pocket calculator is its ability to display visual information. I'd experimented with dynamic artforms on a black and white display, now was the time for colour.

The Ideal Solution

That was the ideal, an 8080/Z-80 CPU, a disk drive and colour at less than, say, $2000. What was the reality? One machine that came close was the Compucolor Corporation's 8051 that I had seen reviewed in 'Byte'. This evidently had an excellent colour display but it was apparently a small business machine at a 'small business' price that was out of my reach. Could I settle for black and white and buy a TRS-80? I nearly did in early 1979 but couldn't arrange a deal for the computer alone. I didn't want to buy the TRS-80 display and cassette unit since I already had a direct drive display and a spare cassette recorder but none of the local dealers offered only the CPU. Should I give up the 8080 and buy an Apple? No use, I could have afforded one but there was no way I could afford a colour TV to use with it, particularly as I was on the point of moving from continental Europe to the UK and didn't want to lumber myself with a non-UK-standard Apple or TV. Anyhow, I've yet to see an Apple produce better than pastel shades and not always those the user wanted either.

Supply Meets Demand

Then came a stroke of luck. The aforementioned Compucolor Corporation produced the Compucolor II, a package containing just what I was looking for at a price well within my limit, problem solved. So how did I go about buying a Compucolor II? Not by popping into my local computer shop and laying a cheque on the counter. I could have, since one or two Compucolors had reached my area, but there was little point in paying the local 150% markup when I was about to leave the country anyway. Even allowing for import duty,

COMPUCOLOR REVISITED

TVA, phone calls and general hassle it would be much cheaper to buy it directly from a dealer in the USA, *or so I thought.*

It didn't quite work out that way. A telephone call to a well-known New York computer dealer revealed that the Compucolor II was in stock, available in the model I wanted, could be shipped to Europe and would work on 50 Hz mains. I'd decided to buy the 16K version, the memory size options are 8K, 16K, 24K and 32K but the Compucolor assembler won't run on the 8K machine. I also decided to buy the middle one of the three keyboards on offer; it has separate keypads for numbers and colours. So off went my cheque for some $1900, including a sum to cover some software and a packet of blank disks. I'd arranged with a local import agent to handle the importation formalities so all I had to do was wait. Sure enough, a month after I'd posted the order the machine arrived, with software and blank disks, but with no manual.

Missing A Trick

Even without a manual, BASIC is BASIC and I found no difficulty in writing, running, saving and loading BASIC programs. Some experimenting led to a list of the graphics symbols and the keys that generated them. More experimenting led to the discovery that pressing the 'command' key along with another key entered a BASIC keyword into the program. I had chosen the machine from a catalogue that listed the commands available in BASIC and in the disk control mode so I knew roughly what to look for. The colour and plotting commands would have remained a mystery but luckily the 'Byte' article on the 8051 had described these in some detail and the Compucolor II responded the same way.

Two things defeated me. I had no idea how to write, load and run machine code on this particular machine and I couldn't get the blank disks to record anything. There were also two hardware faults. One was a ripple down the right hand edge of the screen that made some characters unreadable, obviously a 50/60 Hz interaction. The other was that every now and then the picture would shrink horizontally, grow vertically and then suddenly snap back to its original size. So, back to the telephone to call New York.

About the missing manual? *"We'll look into it".*

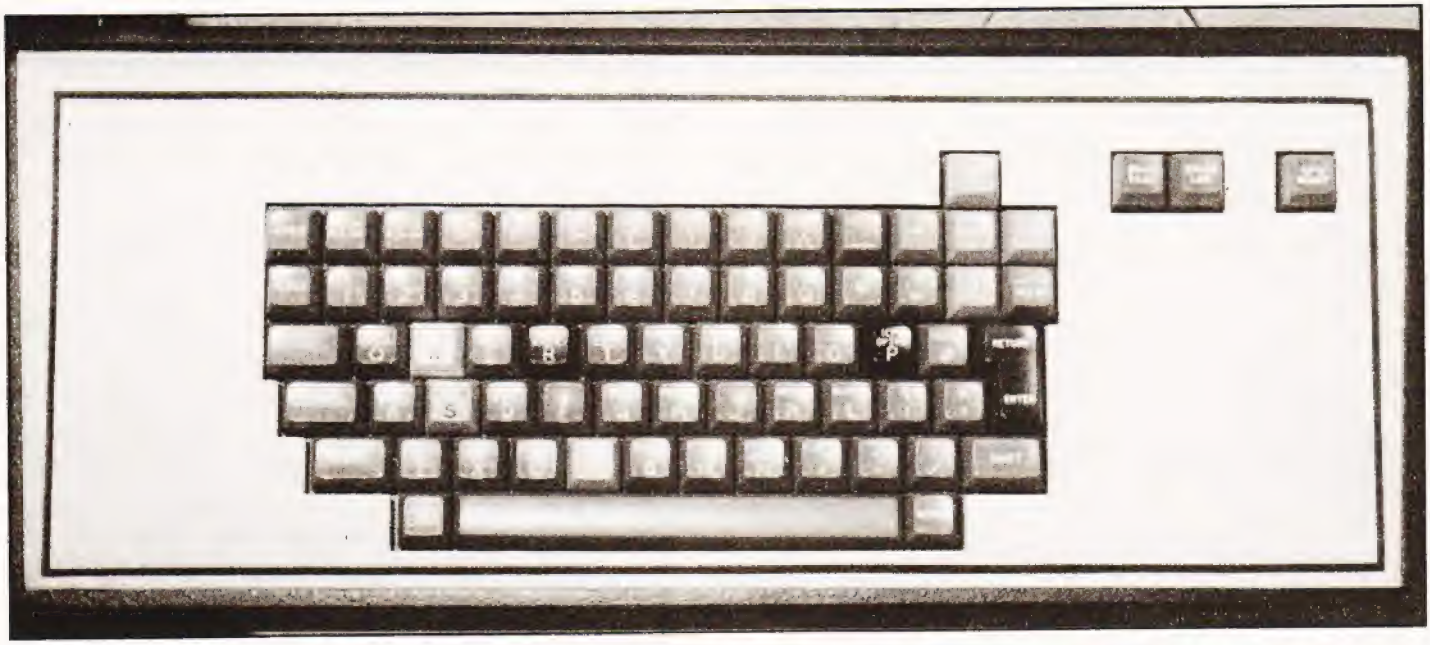
About the disks, on my prompting they admitted that, as I was beginning to suspect, the Compucolor can't format blank disks (I'd spent hours trying) and can only be used with special preformatted disks. *"Send back the regular disks"*, they said, *"and we'll exchange them"*. I did and they didn't, there goes $50.

About the jumping picture? *"Send us the faulty cards and your credit card number"*. Not something likely! By that time I was in the throes of moving house so I wrote to the makers, copy to the suppliers, to register my complaints. Neither replied!

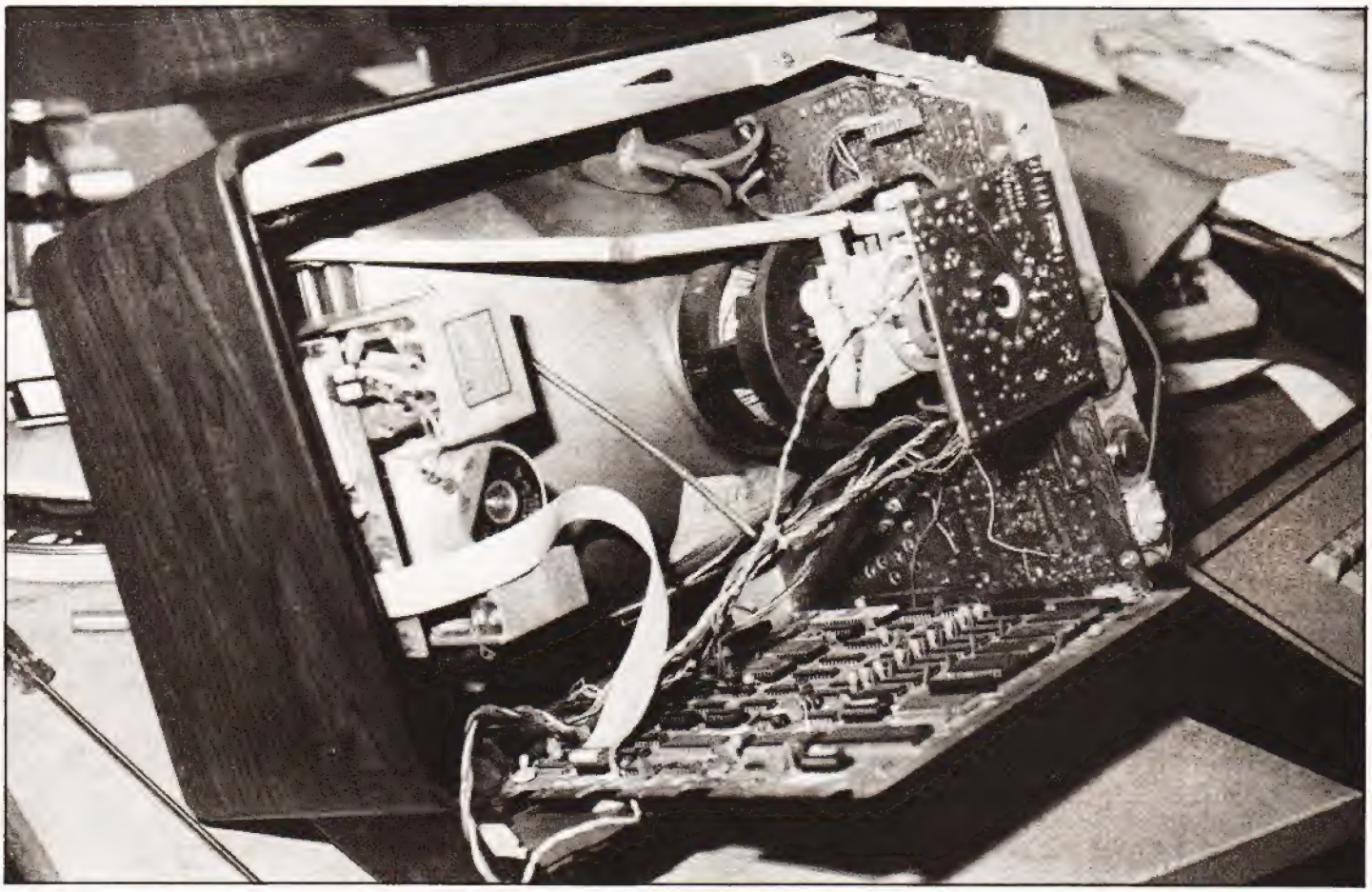
Home Sweet Home

On arriving in Britain (and paying VAT on top of the TVA I had just paid, I hadn't reckoned on that) I checked out the computer again. Sure enough, the fault was still there. Two days later there came a distinct "phut" and the computer went dead. Further letters went unanswered (and I still had no manual) so I got in touch with the UK Compucolor agents (Abacus) who recommended a repair agent to whom I sent the offending cards at the end of July 1979 and who later collected the rest of the machine. At the time of writing (March 1980) they still have it. I grant you, they recently lent me one of their own machines so software development is still proceeding but in BASIC since theirs is an 8K machine and can't run the assembler disk I bought. By this time I had given up and bought a manual from Abacus so I now know how to read and write files and where the machine code jump vector is located but I can't understand why not even the simplest introductory manual was included with the machine.

If I had been living in Britain and had wanted to buy a computer about six months later once it had become established here, I could have bought the same



The neatly laid out keyboard gives "single keystroke" programming in BASIC as well as allowing colour changes and many other functions.



Poor internal layout has caused a number of serious problems including total destruction of the electronics in some cases.

machine for a somewhat higher price but with much less trouble and I would have had someone in this country to grumble to. The original plan had been to transfer my software collection from tape to disk, hence the need to purchase the machine before moving, but the absence of the manual foiled that. Now I have the manual but not the equipment to read the tapes. You can't win and I'm not even sure if I'll have broken even once the repair bill comes in.

System Appraisal

End of grumbles. The Compucolor II is a magnificent machine and it provides a better package than any other home computer in its class. In a case, intended for a portable TV, the makers have included a 13 inch shadowmask tube with direct drive to the three guns, a combined switching mode power supply (110V) and scan generator, a stripped down 5¼ inch disk drive fitted where you would expect to find the TV tuner and a 9 by 10 inch CPU board with 16K of firmware in ROM and up to 20K of RAM (counting the 4K display refresh RAM). Additional PROMs and RAM can be added on little piggy-back boards above the on-board memory. The only external parts are a 240-110V mains transformer and the keyboard.

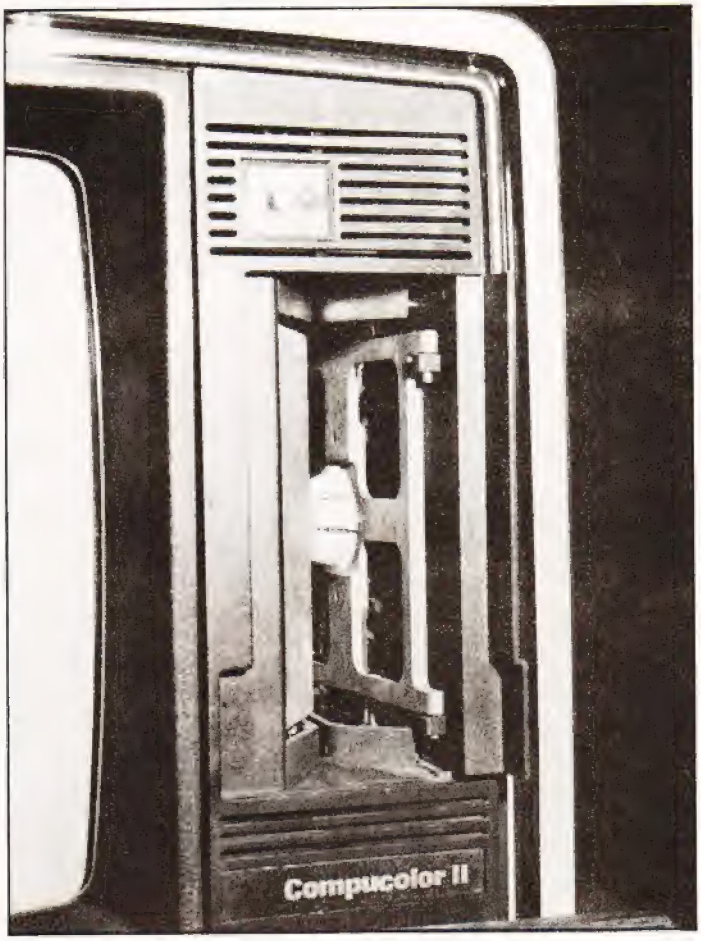
With direct drive to the CRT there are no limits to the colour saturation but the resolution is limited by the spot size and the grain of the shadowmask so the 7 by 5 characters in an 8 by 6 matrix tend to run together just a bit. The machine provides a choice of eight foreground and background colours for each character in the 32 line by 64 character display. Any character can be made to appear blinking or with double height and any character block can be split into eight individually controlled plotting points sharing common foreground and background colours. Thus graphics mixed with characters can be plotted with 128 by 128 point resolution. In addition, the character set includes 64 graphics symbols that permit plotting such things as chess pieces and playing card pips as well as rather spindly alphanumerics occupying a 2 by 2 character space. It should also be noted that if one can accept a resolution of 32 by 64 one can create pictures in up to 63 pastel shades by using the NULL character.

Spinning The Disk

Within its limitations the disk drive is fast and efficient. Data on disk can be accessed in several different ways using either BASIC or the so-called File Control System mode. The disks are double sided and their capacity of only 51 kilobytes per side (40 tracks of 10 sectors of 128 bytes) has not yet limited what I want to do with them. A second external disk drive can be fitted. No write protect is possible and, as I mentioned, you have to use Compucolor disks, currently £8 for two.

Apart from an extra disk drive, Compucolor do not offer any peripherals but the machine has an RS232 port that can drive almost any printer and all the 8080 signals one could want are available on a 50 way edge connector. Perhaps someone will develop some add-

COMPUCOLOR REVISITED



The neatly integrated disc unit fits where the TV tuner is normally found.

ons and adaptors if there is enough demand. One of the operating modes of the Compucolor permits it to be used as a dumb terminal for another computer, dare I suggest it as a colour display to the users of some other well known micros?

Encased Software

The firmware is excellent. Into 16K of ROM is packed a pretty complete six digit floating point BASIC, a disk operating system with twelve commands and a, so-called, CRT mode that permits the user or a remote computer to place all sorts of text and graphics on the screen in any desired colour combination and then store or transmit the result. BASIC has been augmented by a PLOT command that, in effect, passes control characters to the screen where they can move the cursor, clear the screen, change the colour being plotted or just enter characters. There is also a special plot mode that permits drawing vectors between any two points on the screen, drawing X and Y bar graphs and plotting incremental vectors. Pressing the ESC key or entering it via a PLOT command leads to 23 further functions that control the machine's use as a variable baud rate, half or full duplex terminal, change the display from page to roll mode or force jumps to BASIC, the disk mode or user supplied machine code routines.

Another command I am finding my way round is the FILE command and its related GET and PUT commands. By following FILE with the appropriate designator and a list of parameters it is possible to create disk files having any size and format one may find convenient. The GET and PUT commands then give access to any item of data on any of the currently open files. It seemed complicated at first glance but a little practice soon showed how the logic of file access worked and I'm now getting real and useful data on and off disks. Compucolor do supply a Personal Data Base program to handle this sort of job but I prefer to write my own.

The Compucolor really makes the most of its disk system, in BASIC one SAVEs and LOADs programs by name in a matter of seconds. Also in BASIC one can save variable arrays directly and one has available the extensive file creation and access facility mentioned above. On activating the file control system, which can be done as part of a running BASIC program, one can load and store blocks of data called by name from or to any part of memory, with the control system maintaining a directory of where each block is and where it should be loaded. These blocks can be machine language programs or even memory maps of the picture on the screen. It takes about a second to recreate the picture from the disk. Further commands permit one to read from or, more dangerously, write to any part of a disk and to delete any program from the disk. Program deletion causes all the other programs on the disk to be moved up to fill the gap. This process uses the screen memory as a buffer and the resulting patterns are a wonder to behold.

Psychedelia Rules

All these multicoloured characters and plotted points are possible because the Compucolor has a 4K screen refresh memory to display 2048 (64 by 32) characters. Thus two bytes are available to specify the contents of each character space. One of these bytes uses three bits each to specify the background and foreground colour of the character and a seventh bit to specify if it is to blink. The seven lower bits of the other byte specify the ASCII or graphics character to be displayed setting the eighth bit doubles the height of this character. If the eighth bit of the colour bytes is set the character byte no longer selects an ASCII character but becomes an eight bit map of the 2 by 4 rectangle comprising one character position. This is how 128 by 128 point plotting is achieved and its only disadvantage is that all the points in one character space have the same colour. This produces odd results when plotting intersecting lines in different colours since some of the points on the first line will change to the colour of the second line.

The Compucolor version of BASIC lacks either a USR or SYS command but accesses machine code routines with a CALL instruction. This has the format A = CALL(B) and causes a jump to a vector stored in locations 33283 and 33284. An 8080 RET instruction at the end of the machine code causes BASIC to continue. The value of B is passed to the code routine in the 8080's DE register and the number in DE at the end of the routine is passed back as the value of A. Obviously if one wishes to pass further parameters one can prestore them in memory using the POKE command before using CALL vector or by using the passed parameter as a pointer to the called routine. Though the manual does not mention it explicitly, it is also

possible to access machine code routines that start at any of the four addresses that can be reached by using the ESC key by putting the appropriate key sequence in a PLOT command. Thus PLOT 27,30 causes a jump to location 33215 where there is just room to put a further jump to the required routine. Once more an RET instruction causes the BASIC program to continue. Of course, in this case any parameters required must be passed explicitly by using POKE and PEEK.

Short machine code routines can be entered as part of BASIC programs by writing them as a series of DATA statements and using a POKE statement inside a FOR loop to load them into memory. Longer routines are worth recording on disk as machine code to be loaded by the BASIC program. The disk control system and the ESC key permit complete machine language programs to be loaded and run without using BASIC at all.

Summary

Now, a few last grumbles. Some things I miss, as an occasional PET user, are ten digit accuracy, lower case characters and the PET's screen editor. It's a nuisance to have to retype a complete line just because one has entered it with one small mistake. The PET's ability to renumber lines is also sorely missed (using a Toolkit!)

One of the reasons I bought a computer was to use it as a word processor to write articles such as this. Not yet having my own machine back I have yet to buy a printer but the lack of a lower case display will limit its use in this way. Indeed the Compucolor II seems to have been designed more for playing games than for any more serious purpose, even the PET has a more versatile, general-purpose graphics character set (though its plotting ability is much poorer). On the other hand, every time I use the PET I find myself trying to type BASIC with single keystrokes, see Table 1. The PET's two stroke entry (press SHIFT on the second letter, in case you didn't know) comes a poor second.

As an engineer I can see that design compromises have had to be made in the Compucolor to keep the price low. I'm not happy about the close link between the line scan system and the power supply that means that a software fault can, in principle, wreck the machine by radically changing the line scan frequency and, though I may have been unlucky, I'm not too convinced of the machine's long term reliability (See our original review in CT for details!) These points apart, I'm very satisfied with the performance of the Compucolor II and I'm pleased to have found a machine that fits my requirements better than I had initially dreamed was possible.

Supply Note

The UK distributors of the Compucolor, Abacus, have decided that owing to the large number of faults encountered they will not supply further sets until the US manufacturer makes modifications. These alterations will prevent the kind of problems that the author, and CT, have encountered and make the system appear rather less of a "good buy" than it should be. Hopefully these alterations will be agreed to in the near future. If you intend to buy a system contact the main distributor to check the current situation.

ABS	C 0
AND	CS 9
ATN	CS ,
CALL	C 1
CLEAR	CS Y
CONT	CS X
COS	C 9
DATA	CS C
DEF	CS Z
DIM	CS E
END	CS @
EXP	C 8
FILE	CS G
FN	CS —
FOR	CS A
FRE	C 2
GET	CS O
GOSUB	CS L
GOTO	CS H
IF	CS J
INP	C 3
INPUT	CS D
INT	C /
LEN	CS .
LIST	CS W
LOAD	CS T
LOG	C 7
NEXT	CS B
NOT	CS 2
ON	CS \
OR	CS :
OUT	CS P
PEEK	CS -
PLOT	CS R
POKE	CS U
POS	C 4
PRINT	CS V
PUT	CS Q
READ	CS F
REM	CS N
RESTORE	CS K
RETURN	CS M
RND	C 6
RUN	CS I
SAVE	CS S
SGN	C .
SIN	C :
SPC(	CS 0
SQR	C 5
STEP	CS 3
STR$	CS /
TAB(	CS]
TAN	C ;
THEN	CS 1
TO	CS ^
WAIT	CS [

The following keywords cannot be entered with a single key.

ASC CHR$ LEFT$ MID$ RIGHT$ VAL

Note : CS means press both the CONTROL and the SHIFT keys. C means press only the CONTROL key.

Table 1. BASIC system commands using single keystrokes.

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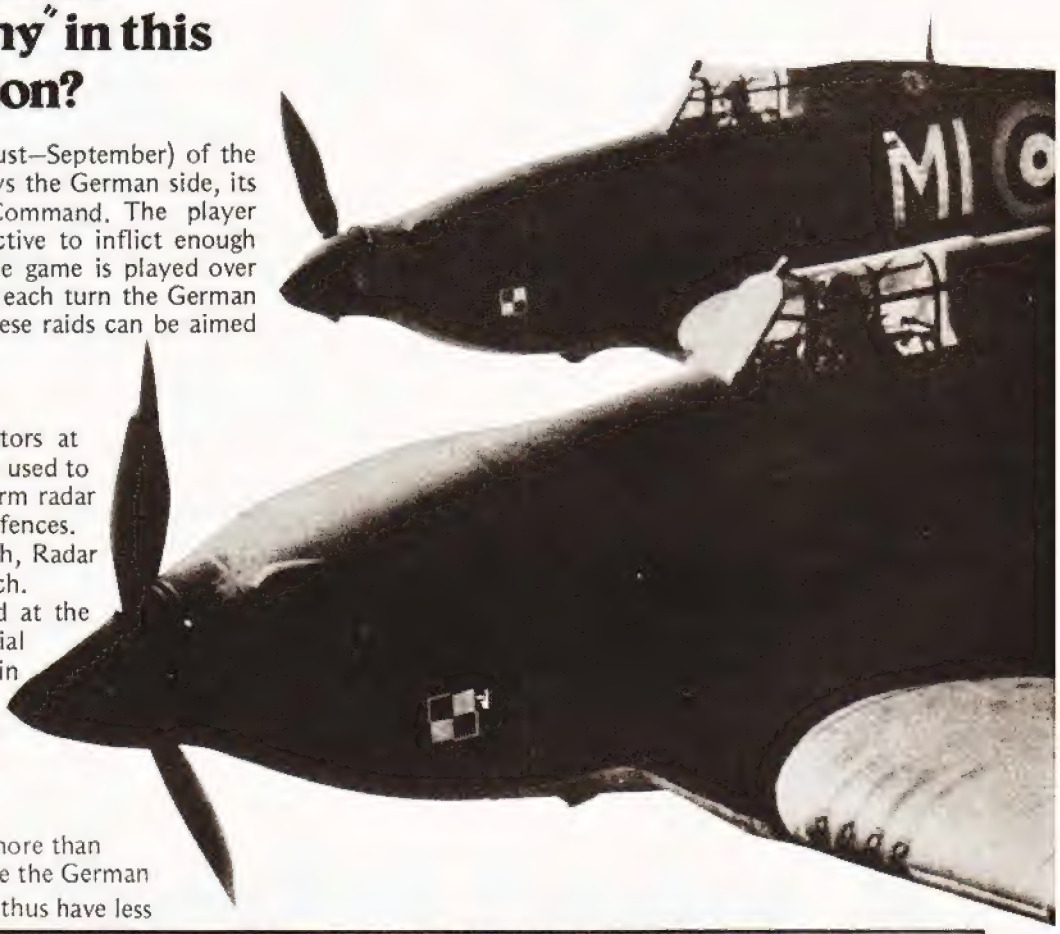


This simulates two months (August–September) of the Battle of Britain. Computer plays the German side, its objective to cripple Fighter Command. The player commands the British side, his objective to inflict enough casualties to deter further attack. The game is played over ten turns, one week per turn. During each turn the German launches three attacks on Britain. These raids can be aimed at:

A – Fighter Bases
B – Radar Stations
C – Industrial Centres

The British have 100 Industrial Factors at their disposal. These factors may be used to build fighters or radar stations. The term radar station also includes various ground defences. Fighters cost one industrial factor each, Radar Stations cost ten industrial factors each.

Industrial Factors are renewed at the start of each week. However, industrial factors can be destroyed by bombing, in which case they are permanently lost, and so the total of available industrial factors will dwindle as the weeks pass.

Notes

In combat, British fighters are worth more than German fighters. This is simply because the German fighters are escorting bombers, and thus have less

BATTLE OF BRITAIN

freedom of action. Industrial factors cannot be replaced because of the small time scale, just ten weeks.

German Experimental fighter-bomber Gruppes have been added to the Bomber force. German 110 twin engine fighters have been ignored, except when operating as bombers.

For the purpose of this game, initial historical German tactics are maintained throughout the entire game.

Historically, heavy casualties forced the Germans to operate small bomber formations with large fighter escorts from mid-September.

British reinforcements, about 100 fighters per week, are accurate. Lack of trained pilots (simulated by switching resources to other things) made this figure considerably lower in practice.

German reinforcements, 40 fighters and 125 bombers per week, are roughly accurate. The fighter figures are correct, the bomber figures are 35% larger, but this simulates return of damaged bombers to field strength. Initial game casualties will be very heavy. Roughly half of the German bomber casualties are regarded as damaged only.

Victory Conditions

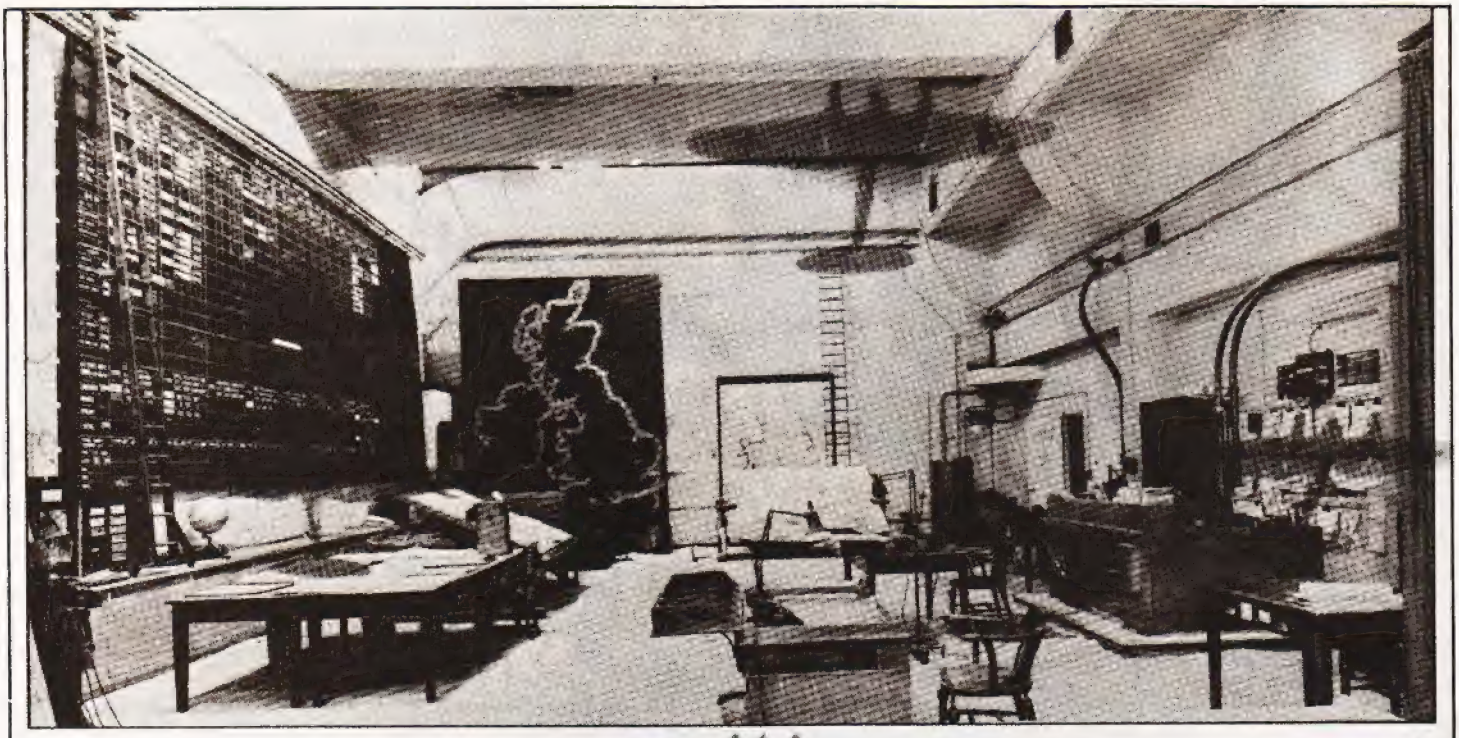
If the Germans have fallen below 1000 bombers at the start of a new move, they will give up the attack, and the British win. You are a hero.

If the British drop below 500 fighters at the start of a new move, they will be invaded and crushed. You will be shot!

If at the end of the game, the British have more points value left than the Germans then the British win by staving off invasion. You will be given a knighthood.

If at the end of the game, the Germans have more points left than the British (bombers count 1, fighters count

BATTLE OF BRITAIN



3) then the Germans will continue their attack, but you won't be there to stop them.

Program Notes

This program uses the variable O which can cause confusion. This has been set as o for indentification. Note that THEN is implied, see lines 270-310 and that the + between brackets in lines like 100 is a logical OR and does not mean add.

```
 10 A=800, B=12, C=100, D=800, E=1600
 20 FOR W=1 TO 10
 30 PRINT #2, 'WEEK  ',W
 40 PRINT #4, 'FIGHTERS',A
 50 PRINT #4, 'RADARS',B
 60 PRINT #4,'INDUSTRIAL FACTORS',C
 80 IF A < 500 PRINT 'YOU HAVE LOST THE WAR
    AND WILL BE SHOT
 90 IF E < 1000 PRINT 'YOU HAVE WON THE
    BATTLE AND ARE A HERO
100 IF (A < 500)+(E < 1000) PRINT;STOP
220 INPUT 'HOW MANY NEW RADARS'P
230 IF C < 10*P GOSUB 1000;GOTO 220
240 INPUT 'HOW MANY NEW FIGHTERS' K
250 IF (C-10*P) < K GOSUB 1000;GOTO 240
255 M=A, N=D, o=E
260 FOR R=1 TO 3
270 IF R=1 Q=RND(2)
280 IF R=2 Q=RND(3)
290 IF R=3 Q=RND(2)+1
300 IF R=1 G=RND(N/2);F=RND(o/2)
305 IF R=2 G=RND(N-1);F=RND(o-1)
310 IF R=3 G=N;F=o
315 N=N-G;o=o-F
320 X=13-B;IF X < 1 X=1
330 Z=((G+F)*X)/10
340 X=RND(2*Z)-Z
350 PRINT #3, 'RAID  ',R
352 IF B < 1 PRINT 'YOUR RADAR IS DEAD';GOTO 357
355 PRINT #3, 'RADAR REPORTS  ',ABS(G+F+X), ' BANDITS'
357 PRINT #4, 'YOU HAVE  ',M, '  FIGHTERS'
360 INPUT 'HOW MANY TO SCRAMBLE'H
364 IF H > M PRINT 'TOO MANY FIGHTERS
    OLD BEAN';GOTO 360
366 M=M-H
370 S=5*H;T=G*3+F
380 IF ABS(S-T)*5 > (S+T) GOTO 420
390 X=RND(3)+8;U=(T+X/2)/X
400 X=RND(3)+8;V=(S+X/2)X
410 GOTO 455
420 IF S  < T GOTO 450
430 U=T/9;V=S/12
440 GOTO 455
450 U=T/12;V=S/9
455 L=U/5;I=0;J=0;IF V > 0 I=(RND(V)+V)/9;J=V-I*3
457 IF L > H L=H
459 IF I > G I=G
461 IF J > F J=F
465 PRINT #4, 'BRITISH LOSSES  ',L
470 PRINT #4, 'GERMAN FIGHTERS  ',I, ' BOMBERS ',J
480 IF S >=T X=8
490 IF S <T X=12
500 IF S < 2*T X=18
510 X=(F-J)*X
520 A=A-L;D=D-I;E=E-J
522 IF Q=2 GOTO 538
523 IF Q=3 GOTO 544
524 X=(X-100)/200;IF X > A X=A
526 IF R=1 M=M-X
527 IF R=2 M=M-X/2
528 IF M < 0 M=0
530 PRINT #4,X, '  FIGHTERS LOST ON GROUND';A=A-X
531 GOTO 560
538 X=(X-2000)/4000;IF X> B X=B
540 PRINT #4,X, ' RADARS LOST';B=B-X
541 GOTO 560
544 X=(X-400)/800;IF X > C X=C
550 PRINT #4,X, ' INDUSTRIAL FACTORS LOST'; C=C-X
560 NEXT R;PRINT
570 A=A+K;B=B+P
580 D=D+40;E=E+125
590 NEXT W
600 IF A*5 > D*3+E GOTO 700
610 PRINT 'THE GERMANS WILL
    CONTINUE THE ATTACK'
620 PRINT 'YOU ARE NOW THE
    AMBASSADOR OF KALAMAZOO'
630 PRINT 'DON'T COME BACK'
640 PRINT
650 STOP
700 PRINT 'YOU HAVE STAVED OFF INVASION'
710 PRINT 'YOU HAVE BEEN KNIGHTED'
720 PRINT
800 STOP
1000 PRINT 'TOO MANY FACTORS';RETURN
```

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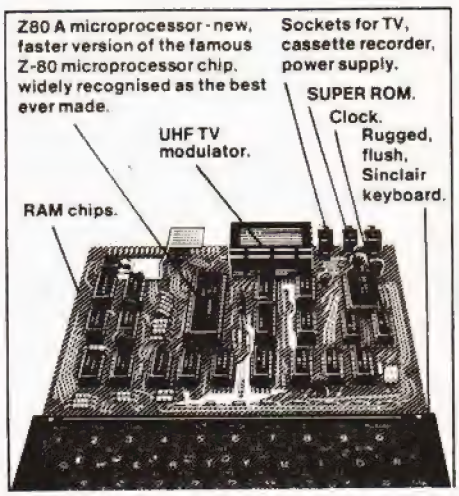

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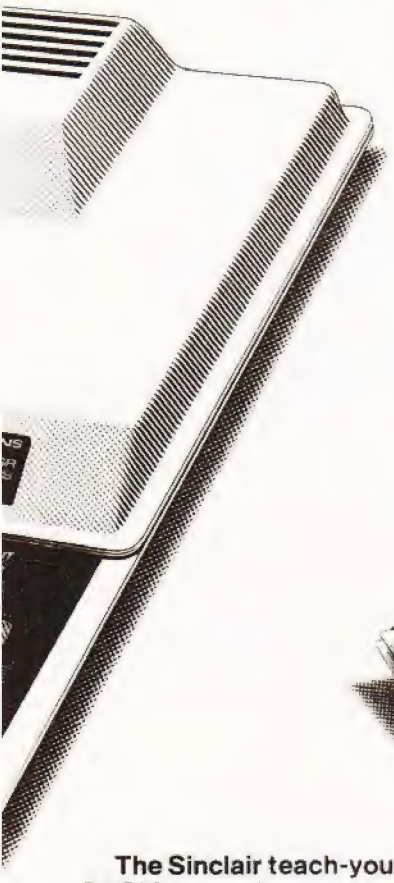

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T. Lacy

How to get round those boring little chores with a bit of machine code magic.

This article is based around a few short programs which were written to illustrate a technique used in certain proprietry software for the TRS-80. Owners of many programs will find this especially revealing as it will explain one or two things that may have been bothering you, ever so slightly.

It is often useful to write programs in BASIC and call subroutines which are written in machine code, USR calls are one of the ways of accomplishing this. The conventional technique is to reserve an area of memory by answering the MEM SIZE query with a suitable number and to then write a BASIC program which READs the machine code, in decimal form, from DATA statements and POKEs them into the reserved memory area. Simple when you put it like that isn't it!

A Graphic Example

As an example of this kind of technique if I wanted to "white-out" the screen I would POKE the required graphics characters into the video memory or PRINT some "all-white" graphic character strings. Both of these methods require a very obvious time interval. What if I wanted to do it fast?

```
                          100                ; Snowstorm, an old demo
                   7F00   110 ORG 7F00H      ; As good a place as any
7F00  21 00 3C            130 LD HL,3C00H    ; Video RAM first address
7F03  36 BF               140 LD (HL),0FFH   ; All white graphics byte
7F05  11 01 3C            150 LD DE,3C01H    ; Put it here
7F08  01 FF 03            160 LD BC,3FFH     ; This many times
7F0B  ED B0               170 LDIR           ; Do it
7F0D  C9                  180 RET            ; Important, back to BASIC
                          190                ; Could go anywhere
                          200 END            ;
```

Fig 1. The machine program to "white-out" the TRS 80 screen.

A program to do the job is given in figure 1. This does the task in a time interval comparable to a frame scan of the VDU. Figure 2 shows the usual way to enter and access this sort of subroutine from BASIC. Run this program and watch your screen "white-out" fast!

A certain, very famous, piece of software Axxxx-xD NxM uses a different technique. When a variable is defined its value is stored, somewhere, in memory so why not define a string variable using characters which correspond to a machine code subroutine? The string of "bytes" will be stored in memory in just the same way as any other string and provided the storage address can be obtained the machine code can be accessed with the USR statement.

Locating The Location

The statement VARPTR(X$) will allow us to discover this address, it can return a decimal number which will tell us where to PEEK for the actual address. The way it is used is as follows :

If V=VARPTR(M$) then;

PEEK(V) will return the length of the string M$ in decimal,

PEEK(V+1) will return the MSB of the start address in decimal and

PEEK(V+2) will reveal the LSB of that address.

To demonstrate this apparent phenomenon enter the program listed in figure 3 and, in response to the "YOUR MOD" query enter the following numbers. 33,1,60,54,255,17,2,60,1,254,3,237,176,201.

Upon entering this little lot you will find that as you enter the last number the screen will "white-out" just like in the previous effort. Lines 40 to 115 and all the REMs can be deleted to give a working program of a mere four lines in length.

The machine code is stored as part of M$ and can be accessed by executing X=USR(0). There are some problems though, the BASIC Interpreter will "recognise" 00Hex as an end of program line and 22Hex as an end of string delimiter and so these must be excluded from the machine code. This explains the slight difference between the two sets of decimal values, there should be a way round this and perhaps someone could enlighten me?

Non Listed Lists

The major "problem" is that when you list programs with embedded machine code routines the machine will try to print the code onto the screen and some of the Hex codes will correspond to the cursor controls. This has the effect of disturbing the scrolling function, to say the very least!

Now you know why some programs you purchase will run properly but never LIST!

```
5     REM DON'T FORGET TO ANSWER MEM SIZE
      WITH 32512
10    DATA 33,0,60,54,255,17,1,60,1,255,3,237,176,201
15    REM THESE NUMBERS ARE DECIMAL EQUIV
      OF HEX IN FIG 1 LISTING
20    FOR X=32512 TO 32525
25    REM 32512 IS START ADDRESS (7F00H)
26    REM AND 32525 IS LAST BYTE ADDRESS
30    READ A:POKE X,A
35    REM GET A BYTE AND LOAD IT
40    NEXT
50    POKE 16526,127:POKE 16527,0
55    REM DEFINE THE SUBROUTINE ENTRY POINT
      FOR THE USR CALL
56    REM MSB=07FH (127D), LSB=00
60    X1=USR(0)
65    REM NOW CALL THE SUBROUTINE
66    REM THIS WILL SHOW THE CONVENTIONAL
      METHOD
```

Fig 2. The BASIC program that incorporates the machine code of the program in Fig 1.

HEX ROUTINES

```
5    REM NO RESERVED MEMORY NEEDED
10   M$="AAAAAAAAAAAAAAA"
15   REM NUMBER OF DUMMY CHARS MORE THAN
     BYTES IN SUBROUTINE
20   V=VARPTR(M$)
30   REM SEE EXPLANATION IN TEXT
40   P1=PEEK(V+1)
50   P2=PEEK(V+2)
60   P3=P1+256*P2
70   REM GIVES START ADDRESS IN P3
80   FOR X=P3 TO PEEK(V)+P3-1
90   REM YOU CANNOT ENTER AS NORMAL CHARS,
     SEE TEXT
95   PRINT"EXISTING ";PEEK(X)
100  INPUT"YOUR MOD ";M
110  POKE X,M
115  NEXT X
120  POKE 16526,PEEK(V+1):POKE 16527,PEEK(V+2)
125  REM SET UP ENTRY POINT FOR USR CALL
130  X1=USR(0)
140  REM NOW DO IT!
```

Fig 3. The method of using a string to load machine code is shown in this BASIC program.

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John Hiscott.

This program is presented as a development on the theme of household management established in my personal accounting system described in the October 1979 issue of Computing Today. By determining gas or electricity consumption from meter readings taken over a selected period of days, the projected weekly, monthly or quarterly cost is calculated which can be used for budgetary control purposes.

A table of a range of costs is available for the single-part tariffs. This could be printed for easy reference by substituting 'LPRINT' for 'PRINT' where required. Domestic tariffs currently available are provided for and the data required should be taken from the last available account or notification of charges.

The program is written in Triton level 7 (8K) BASIC. Users of Triton level 6 BASIC should alter the string variables to numeric and make syntax changes as needed. The listing is given together with a specimen run printout.

```
 0 CLS
 5 PRINT "DOMESTIC FUEL COSTING PROGRAM"
10 PRINT  "*****************************"
15 INPUT "ENTER 'G' (GAS) OR 'E' (ELECTRICITY)";
   A$
25 IF A$="E" GOTO 70
30 INPUT "ENTER FIRST COST PER THERM (IN
   PENCE)";A
40 INPUT "ENTER NO. THERMS APPLICABLE
   ABOVE";B
50 INPUT "ENTER SECOND COST PER THERM (IN
   PENCE)";C
60 INPUT "ENTER CALORIFIC VALUE (BTU PER CU.
   FT.)";X
65 GOTO 120
70 PRINT "ENTER '1' FOR STANDING DOMESTIC
   TARIFF"
80 INPUT "ENTER '2' FOR TWO-PART TARIFF";E
85 IF E=2 GOTO 100
90 INPUT "ENTER UNIT CHARGE (IN PENCE)";A
95 GOTO 120
100 INPUT "ENTER UNIT CHARGE - DAY RATE (IN
   PENCE)";A
110 INPUT "ENTER UNIT CHARGE - NIGHT RATE (IN
   PENCE)";C
120 INPUT "ENTER QUARTERLY CHARGE (N.B. - IN
   PENCE)";I
125 IF E=2 GOTO 195
130 PRINT "ARE CALCULATIONS REQUIRED FOR A
   SINGLE READING"
140 INPUT "OR A RANGE OF READINGS - ENTER 'S'
   OR 'R' ";C$
145 IF C$="S" GOTO 180
150 INPUT "ENTER LOWEST READING OF RANGE";J
160 INPUT "ENTER HIGHEST READING OF RANGE"
   ;K
170 INPUT "ENTER VALUE OF STEPS BETWEEN
   EACH READING";L
175 GOTO 220
180 IF E=2 GOTO 195
185 INPUT "ENTER CONSUMPTION FOR PERIOD";Y
190 GOTO 220
195 INPUT "ENTER DAY-RATE CONSUMPTION FOR
   PERIOD";U
200 INPUT "ENTER NIGHT-RATE CONSUMPTION
   FOR PERIOD";V
220 PRINT "ENTER NUMBER OF DAYS COVERED
   BY READING"
230 INPUT "(N.B:- ONE QUARTER IS 91 DAYS)";D
300 PRINT "-------------------------------"
310 PRINT D;"DAYS",
330 PRINT "PROJECTED PROJECTED PROJECTED"
340 IF A$="G" PRINT "CU FT",
350 IF A$="E" PRINT "UNITS",
360 PRINT "WEEKLY     MONTHLY   QUARTERLY"
370 PRINT "METER      COST      COST      COST"
380 PRINT "READING (POUNDS) (POUNDS) (POUNDS)"
400 PRINT "-------------------------------"
410 IF C$="S" THEN M=Y:J=Y:K=Y
415 IF E=2 THEN M=Y:J=Y:K=Y
420 FOR M=J TO K STEP L
425 N=91/D
430 IF A$="E" GOTO 465
440 O=M*X/1000*N
450 IF O>=B THEN P=O-B
460 IF O>=B THEN O=B
465 IF E=1 THEN O=M*N
470 IF E=2 THEN O=U*N:P=V*N
475 Q=O*A
480 IF E=1 GOTO 490
485 R=P*C
490 S=Q+R+I
500 T=S/100
505 IF E=2 GOTO 525
510 PRINT MTAB(10)T/13TAB(21)T/3TAB(32)T
520 NEXT M:GOTO 540
525 PRINT U+VTAB(10)T/13TAB(21)T/3TAB(32)T
530 PRINT "(COMBINED DAY PLUS NIGHT UNITS)"
540 END
```

The program listing for 'Fuel Costing'.

```
   RUN
DOMESTIC FUEL COSTING PROGRAM
*********************************
ENTER 'G' (GAS) OR 'E' (ELECTRICITY) G
ENTER FIRST COST PER THERM (IN PENCE) 24.6
ENTER NO. THERMS APPLICABLE ABOVE 52
ENTER SECOND COST PER THERM (IN PENCE) 16.5
ENTER CALORIFIC VALUE (BTU PER CU. FT.) 1017
ENTER QUARTERLY CHARGE (N.B' - IN PENCE) 216
ARE CALCULATIONS REQUIRED FOR A SINGLE
READING OR A RANGE OF READINGS - ENTER 'S' OR
'R' R
ENTER LOWEST READING OF RANGE 1.5
ENTER HIGHEST READING OF RANGE 2
ENTER VALUE OF STEPS BETWEEN EACH READING .1
ENTER NUMBER OF DAYS COVERED BY READING
(N.B:- ONE QUARTER IS 91 DAYS) 1
-------------------------------
1 DAYS      PROJECTED   PROJECTED   PROJECTED
CU FT       WEEKLY      MONTHLY     QUARTERLY
METER       COST        COST        COST
READING     (POUNDS)    (POUNDS)    (POUNDS)
-------------------------------
  1.5       2.25211     9.75913     29.2774
  1.6       2.36957     10.2681     30.8044
  1.7       2.48703     10.7771     32.3314
  1.8       2.6045      11.2862     33.8585
  1.9       2.72196     11.7952     35.3855
  2         2.83942     12.3042     36.9125
READY
>
```

A sample run of the program.

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A very powerful assembler-based system for program development could be realised on a NASCOM-2 with appropriate external memory by fitting the 8 ROMs containing ZEAP, NAS-DIS and NAS-DEBUG into the sockets on the computer board. This system would function immediately on switching on, without needing programs to be loaded from tape. Supplied in a 2708 EPROM at £15.00 plus VAT and must be operated with NAS-DIS.

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M.J. Bell

Program developement is the key to successfull software.

Program development is most successfully achieved by beginning with a very brief flowchart showing the major functions to be carried out. This can then be enlarged by adding more and more detail until a fully workable schematic has evolved. It should then be possible to theoretically follow through the chart checking that each eventuality has been catered for.

Calendar Theory

Continuing with the Gregorian Calendar program that we started to develop last month we can prepare a series of flowcharts. The first and simplest is shown in Fig.1 as just 5 all-embracing boxes itemising the main functions.

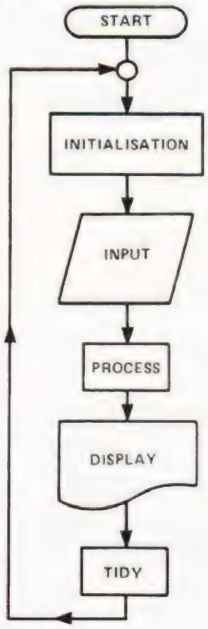

Fig.1. The initial flowchart for any programming task.

INITIALISATION — This box is always present in a program and is used to set up counters, registers and to prepare that display. (eg clear the screen and set the cursor).

INPUT — The input box will contain the program to display the input question or prompt, to accept the data offered at the keyboard and to store it ready for analysis.

PROCESS — As its name suggests working processes of the program are all lumped together in this one box. It will have to encompass all the procedures required to interpret the input, to manipulate the data to achieve the required answer and to prepare it ready for display.

DISPLAY — Usually situated at the tail end of the flowchart the display functions can often be spread throughout the program. This is done to reduce the apparent operating time of the processor. It is better to have the display build up as the program proceeds than to wait till the end to do it all. However, having said that, this program will give little scope for speeding the display routines. Nevertheless at this stage of development it can all be conveniently lumped together in one box.

TIDY — We will add this box at this stage although it may not be needed. Usually with a regenerative program, (ie one that will continue to repeat itself until aborted) it will be necessary to tidy up the stack or data strings before jumping back to the beginning to start again. Sometimes this stage can be incorporated in the initialising routines.

Expanding The Flowchart

Before we can put pen to paper further some thought must be given to the way we are to tackle this problem. The input for example will be written onto the display and therefore will be located in the VDU RAM. If left there for the calculation part of the processing it need not be transferred to temporary registers, but it will be necessary to know where the MONTH data ends and the YEAR data begins. The main processing to be done is mathematical so here it would be advantageous to convert the decimal number into hexadecimal, particularly as it could then be contained in a register pair. The mathematical analysis can be carried out in stages by first considering the centenary years, then the repetitive 28 year cycles. The leap years can be considered separately. The more experienced software "engineers" amongst you are probably jumping up and down thinking of faster ways, but the simplest ways are generally the ones that cause less headaches in the long run. As we know that March 1st 1756 fell on a Monday we can use a register to record the day number that the first of March will fall on in each year.

If, for example, we count a leap year then the day is advanced by one. A centenary year will not advance the day number but decrement it so that the normal leap year routine can be used and the advancement thus achieved would result in a zero shift. As for the shifting the day to correspond with the first of each month in the year it was decided to make use of a look-up table. The first three letters of each month are followed by the number of days in that month, and the offset to be added to the day number. The final result should now be in a form that the display routine can use to present the calendar.

It is usually good policy to leave the initialising routines until the main body of the program is completed so we will begin to build on the "INPUT" stage.

Getting It In

The input stage, as we have seen, is to cater for the prompting of an input, the keyboard routine with its VDU display and the storing of the YEAR memory address. To achieve this the monitor memory routine can be used together with the output routine. Analysis of each input character can determine when a 'space' has been entered and therefore it can be deduced that the next memory location will contain the start of the YEAR number. See the enlarged flowchart shown in figure 2. With this flowchart we have sufficient information to convert this routine into a machine code listing.

Computation And Calculation

As this is the largest part of our program it will have contained the most thought effort and numerous scratch-pad flowcharts would have been produced before satisfying ourselves that we were attacking the problem in the right way. To publish all these thoughts would be laborious (and not very fruitful) so what follows are the two main stages that are the most useful.

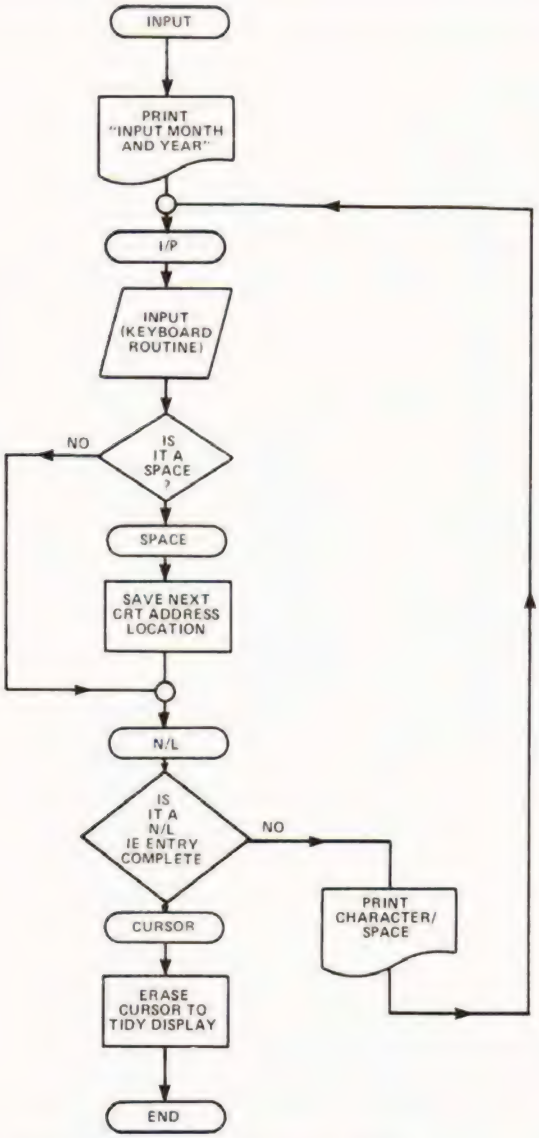

Fig.2. A flowchart segment for the INPUT routine.

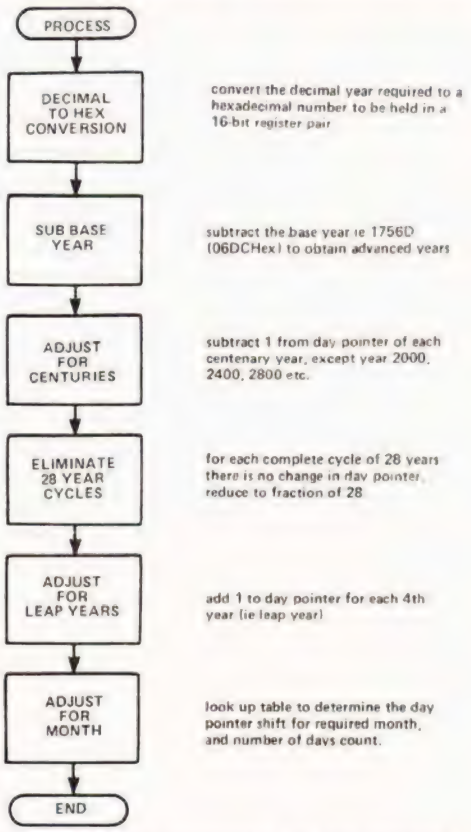

Fig.3. The main stages of data processing that are required.

The flowchart is now enlarged to indicate the main stages in the processing of the data. This flowchart is shown in figure 3. A much clearer idea can now be gained and the problem has been broken down into more manageable segments. A flowchart can now be produced for each segment, and by bearing in mind what has been done before, the whole can be successfully integrated at the end.

The step of altering the year base does not require a more detailed flowchart because having converted the year to Hex the base year can simply be subtracted by using a double byte (16-bit) subtraction instruction.

Year Cycle Elimination

If the year difference is recovered from store, 1C Hex (ie 28D) can be repeatedly subtracted from it until the result is negative. If 1C Hex is then added to the result an answer between 1 and 27D will be obtained. ie the fraction remaining of the 28 year cycle. This can now be analysed into leap years as the starting point (1756) was itself a leap year.

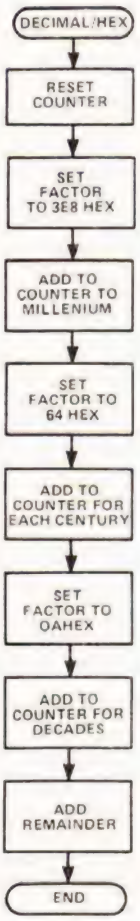

Fig.4. The Hex conversion flowchart.

Figure 6 is fairly self explanatory except for one detail. Why advance the day pointer by five if there is a leap year or it passes through a leap year? The answer is that there is naturally a one day advance in a normal year, therefore in a four year period the advance is 4 days + 1 day for a leap year. Again the incrementing of the day pointer is repeated several times and can be a subroutine. This brings us to the final section, that of calculating the advance of the day pointer due to the month of the year. Here the theory is that the day that the first of the month falls on is always a fixed relationship with the day that the first of March falls on. Until now all our manipulation of the day pointer has told us which day the first of March falls on in the required year. The offset for each month can be put in a table together with the number of days that each month contains. Only the first three letters of the month need to be used for identification purposes.

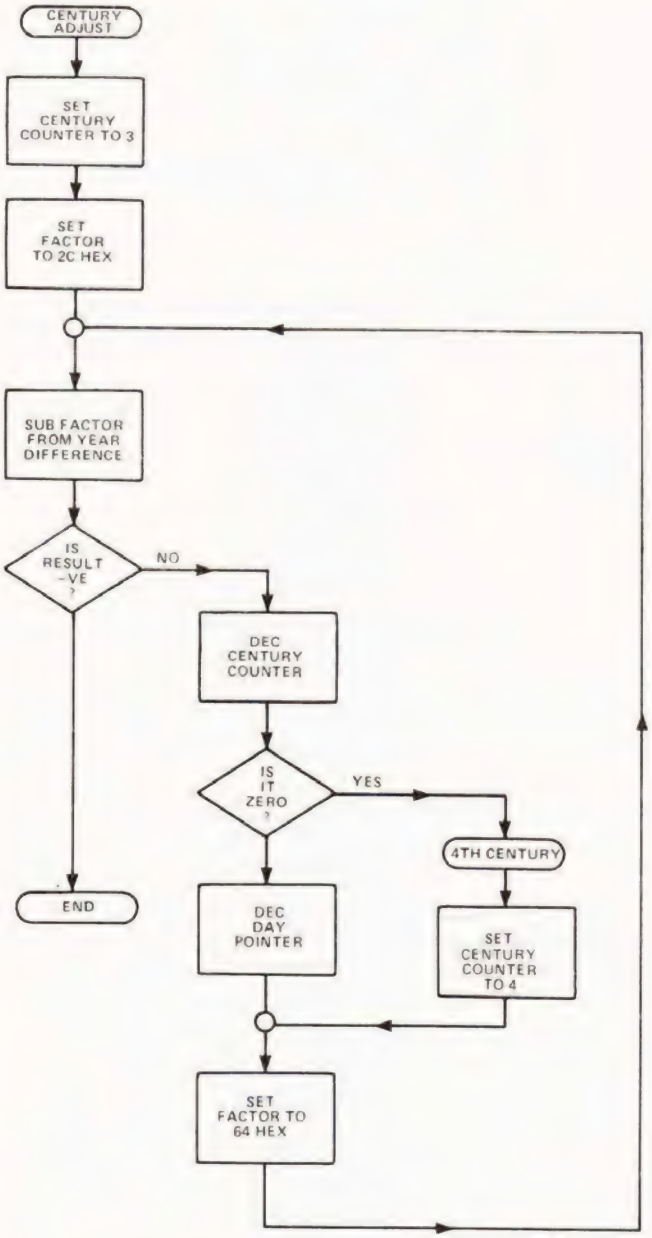

Fig.5. How to adjust for centuries.

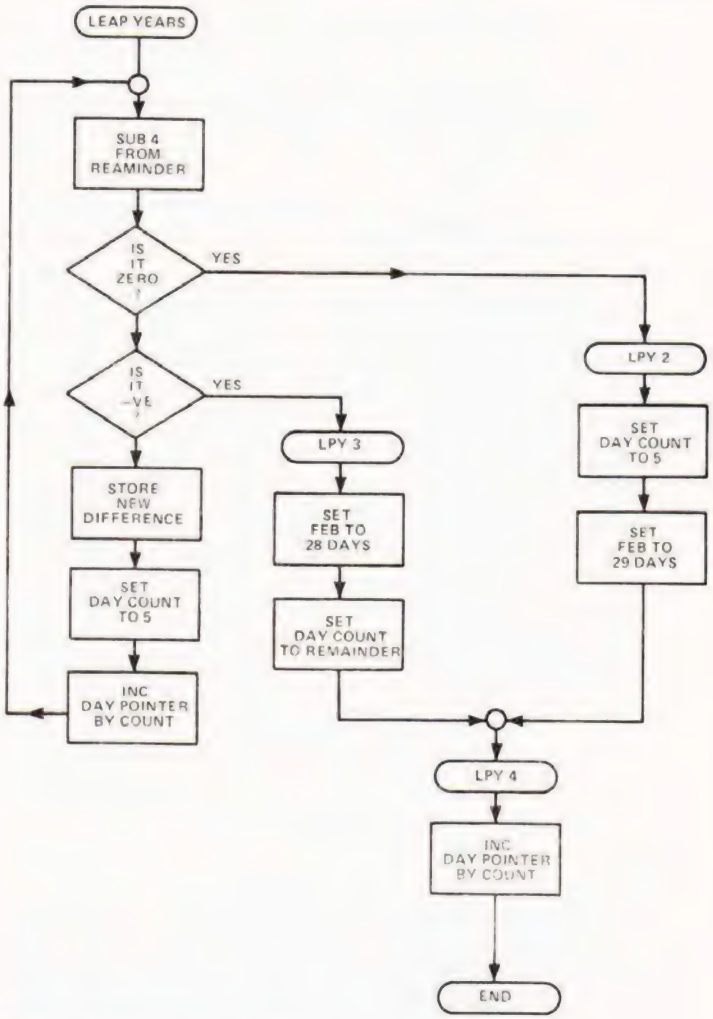

Fig.6. The leap year trap flowchart.

Display Stage

The display stage can now be considered and this will be divided into two parts; Printing the days down the left hand side of the screen, and adding to the display the numbers 1 to 28,29,30 or 31 as appropriate

The first of these two parts is most simply achieved using the "print and scroll" technique. This means the monitor routine for printing a string of text can be used. Each day of the week is loaded as data preceeded by two space characters and suffixed by a scroll and return character. This will result in the days being aligned two spaces from the left and, by adding further scroll characters at the end, they are centrally positioned on the screen. Unfortunately this will have removed the "INPUT month and year" from the screen so we must add a routine to copy the Month and Year information to the top of the screen as a final display title.

The numbers are a little more complex. The cursor can be positioned at the first column adjoining Sunday and then moved vertically to the correct starting day by decrementing the day pointer. However it must be remembered that when Saturday has been passed a new column must be started until the final day as set by the day count in the table is reached. The routine is now complete as can be seen from the flowchart in figure 8.

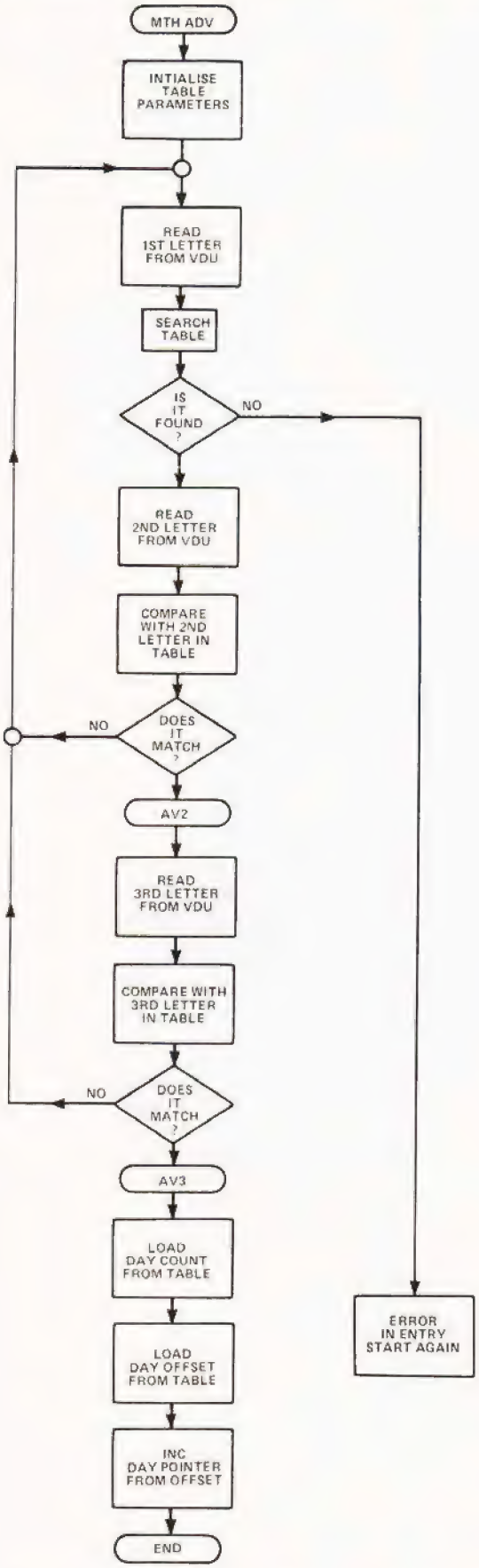

Fig.7. How the days in a month are trapped from the input name.

Setting Up Parameters

It is now clear what initialisation is necessary for the program to be put into operation and, in fact, there is very little to do. The facilities of the initialisation section can best be written down;

1. Clear the screen
2. Print a title on the top line.
3. Set the day pointer to day 1 to coincide with the 1st March 1756.
4. Set the cursor ready for the INPUT section.

The "Tidy" section cannot be completed until the machine code realisation is finished.

Although it was promised that Structured Programming would be dealt with in this part it was felt that it would be better associated with the final part of the series on machine code realisation. Suggestions will also be offered on the documentation of the programs that you write.

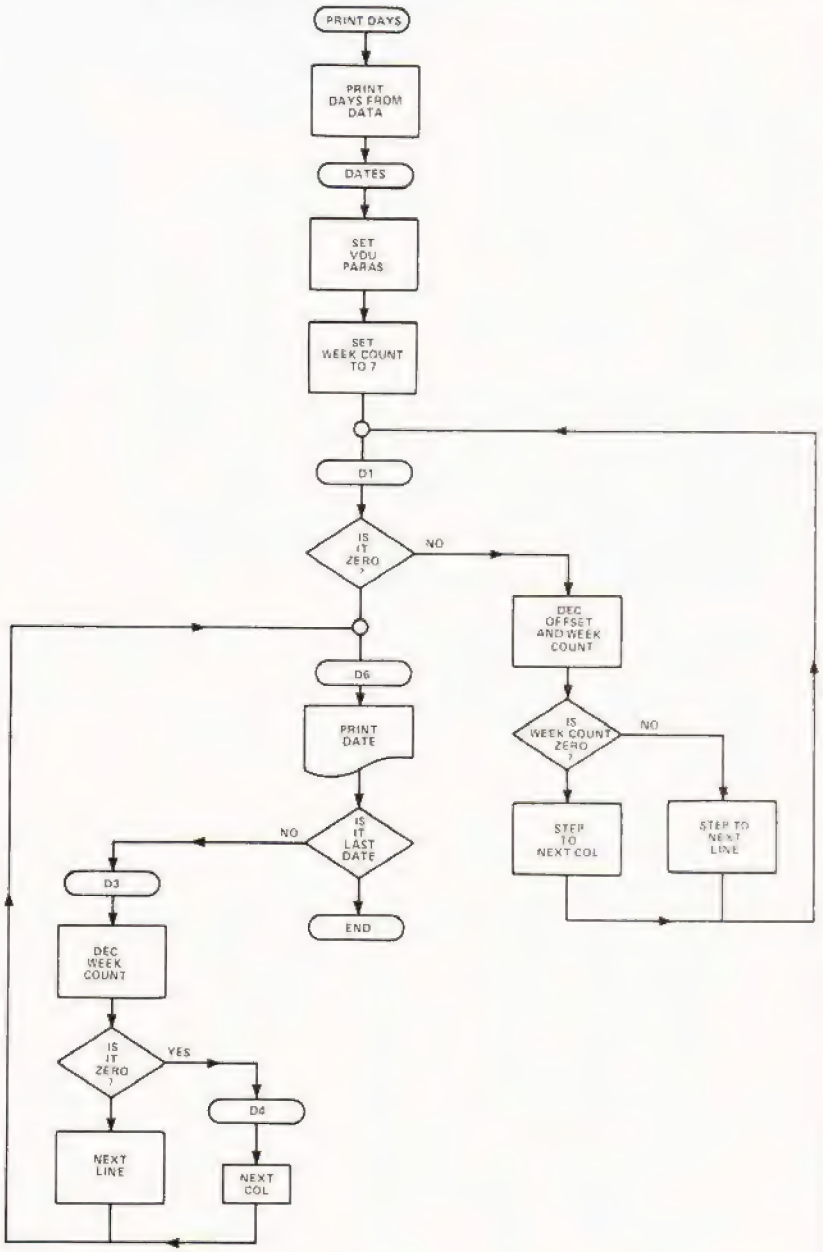

Fig.8. The display segment of the program in flowchart form.

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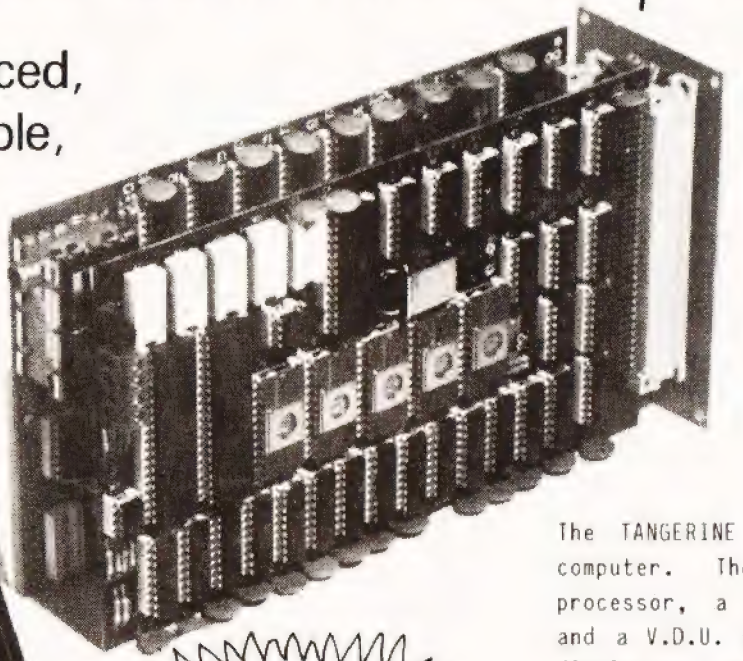

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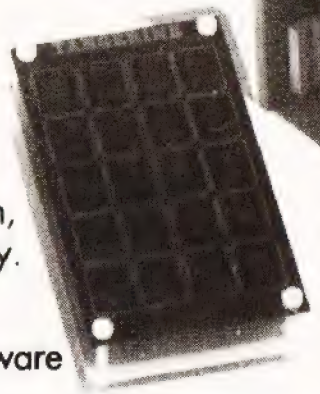

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```
                0010  ;          **** CENTRONICS P1 ****
                0020  ;          **** PRINTER ROUTINES ****
                0030  ;
                0040  ;  For Nascom 1 and 2 using NASBUG or
                0050  ;  NAS-SYS monitors. The routine is
                0060  ;  relocatable.
                0070  ;
                0080  ;  Printer connections:
                0090  ;  PORT Socket:          Printer socket:
                0100  ;  PORT 4, BIT 0         = BUSY (11)
                0110  ;  PORT 4, STB           = Ground (16)
                0120  ;  PORT 5, BITS 0 -- 6   = DATA 1 -- 7 (2 -- 8)
                0130  ;  PORT 5, BIT 7         = STROBE (1)
                0140  ;  GND                   = Ground (16)
                0150  ;  GND                   = Chas. Ground (17)
                0160  ;
                0170  ;  Routine INIT should be called as a
                0180  ;  subroutine to initialize the ports.
                0190  ;  Note that RESET on Nascom 2 will
                0200  ;  disable the ports, RESET on Nascom
                0210  ;  1 will not affect the ports.
                0220  ;
                0230  ;  To print a character, the routine
                0240  ;  PRINT should be called with the
                0250  ;  character to be printed in A. All
                0260  ;  registers will be preserved.
                0270  ;
                0280  ;  Note that the printer will not print
                0290  ;  until a Line Feed is received, and
                0300  ;  Carriage Returns are converted to
                0310  ;  Line Feeds. Therefore if a CR/LF is
                0320  ;  sent, two line feeds will occur.
                0330  ;
000D            0340  CR   EQU #0D ; Code for Carriage Return
000A            0350  LF   EQU #0A ; Code for Line Feed
                0360  ;
0000            0370       ORG #0000 ; Origin of program
                0380  ;
                0390  ;
                0400  ;  Save the contents of A, enable port
                0410  ;  4 to input, port 5 to output, restore
                0420  ;  the contents of A, and return.
0000  F5        0430  INIT  PUSH AF : Save anything in A
0001  3E 4F     0440        LD  A, #4F ; Initialize PORT 4 to i/p
0003  D3 06     0450        OUT  (6), A
0005  3E 0F     0460        LD  A, #0F ; Initialize PORT 5 to o/p
0007  D3 07     0470        OUT  (7), A
0009  F1        0480        POP  AF ; Restore A
000A  C9        0490        RET ; Return from routine
                0500  ;
                0510  ;
                0520  ;  Save the input character, test it to
                0530  ;  see if it is a CR, if so, change it
                0540  ;  to a LF.
000B  F5        0550  PRINT  PUSH AF ; Save the char. in A
000C  FE 0D     0560         CP  CR ; Is it a Carriage Return
000E  20 02     0570         JR  NZ PRINT1 ; No, jump to PRINT1
0010  3E 0A     0580         LD  A, LF ; Change it to a Line Feed
0012  F5        0590  PRINT1  PUSH AF ; Save the char. in A
                0600  ;
                0610  ;  Get the BUSY signal, and test, if ON
                0620  ;  or OFF. If BUSY, go round testing the
                0630  ;  BUSY, until free.
0013  DB 04     0640  PRINT2 IN  A, (4) ; Get the BUSY signal
0015  CB 47     0650         BIT 0, A ; Test it
0017  20 FA     0660         JR  NZ PRINT2 ; If high, jump to PRINT2
                0670  ;
                0680  ;  Restore the character in A. Make
                0690  ;  sure bit 7 is high, send it to
                0700  ;  printer. Reset bit 7 low, to cause
                0710  ;  a STROBE pulse, send it. Set bit 7
                0720  ;  high to clear STROBE pulse, send it
0019  F1        0730        POP  AF ; Restore the char. in A
001A  CB FF     0740        SET  7, A ; Set bit 7 high
001C  D3 05     0750        OUT (5), A ; Send to printer
001E  00        0760        NOP  ; Wait a bit
001F  CB BF     0770        RES  7, A ; Reset bit 7 low
0021  D3 05     0780        OUT (5), A ; Send to printer
0023  00        0790        NOP  ; Wait a bit
0024  CB FF     0800        SET  7, A ; Set bit 7 high
0026  D3 05     0810        OUT (5), A ; Send to printer
                0820  ;
                0830  ;  Restore the original character in A
                0840  ;  and return from routine.
0028  F1        0850        POP  AF ; Restore char. in A
0029  C9        0860        RET  ; Return from routine
                0870  ;
                0880  ;          END OF LISTING
```

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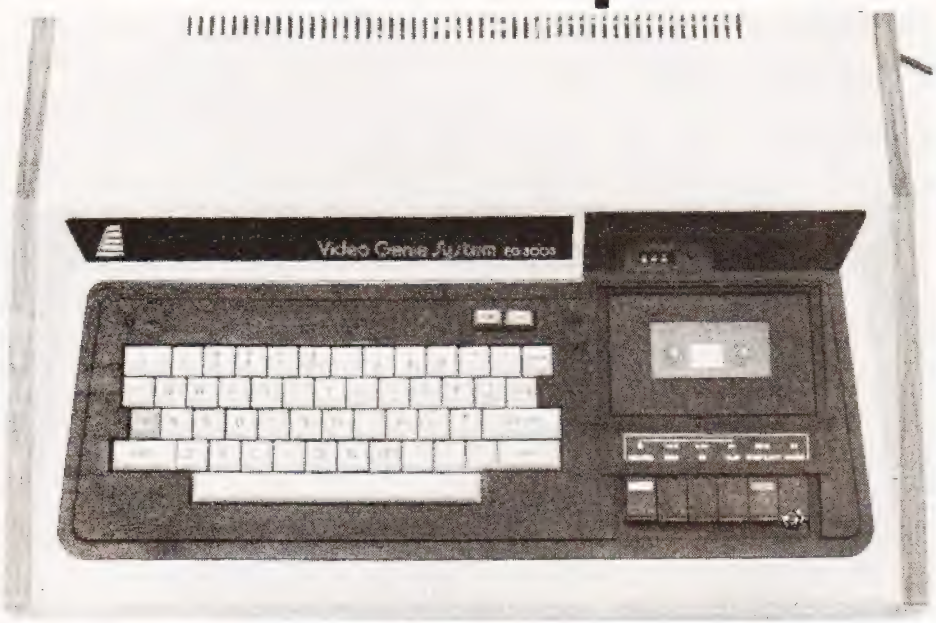

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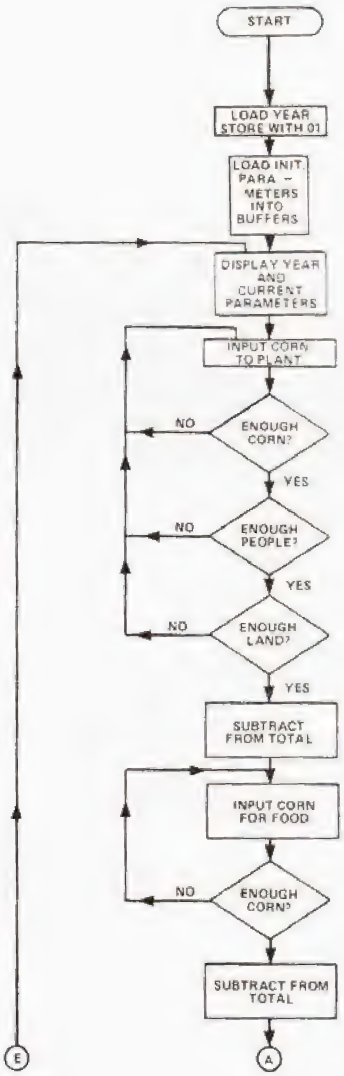
Game Play

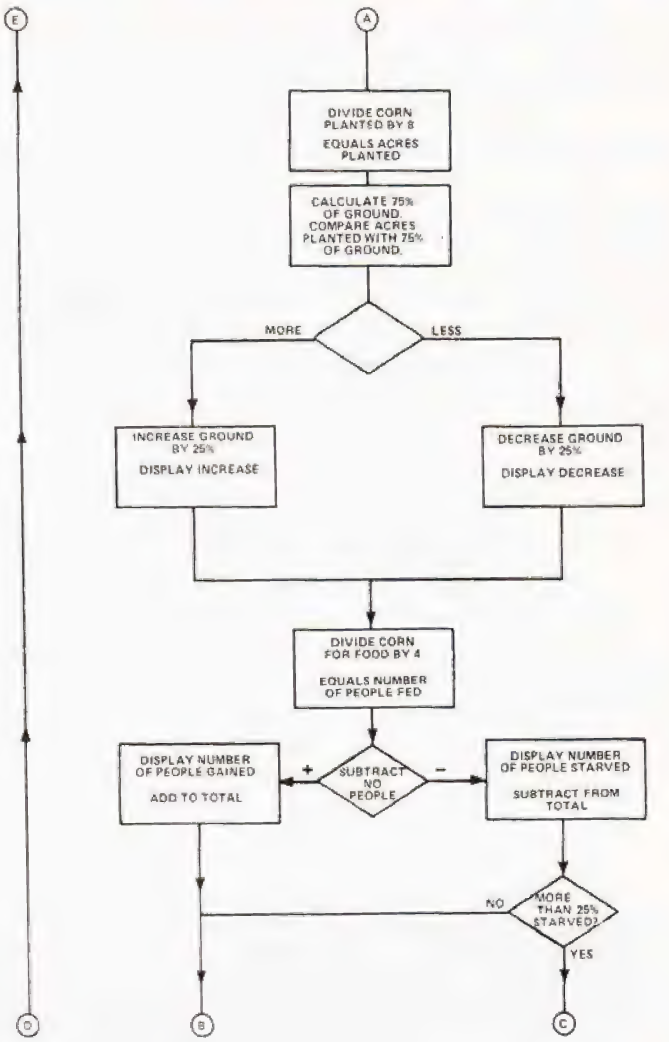
If less than 75% of the ground is planted, 25% is deducted the following year. If between 75 and 100% is planted you will gain an extra 25% in the following year. If more than 25% of the population is starved an assassination attempt is generated, you may survive to carry on but if you don't then the game ends!

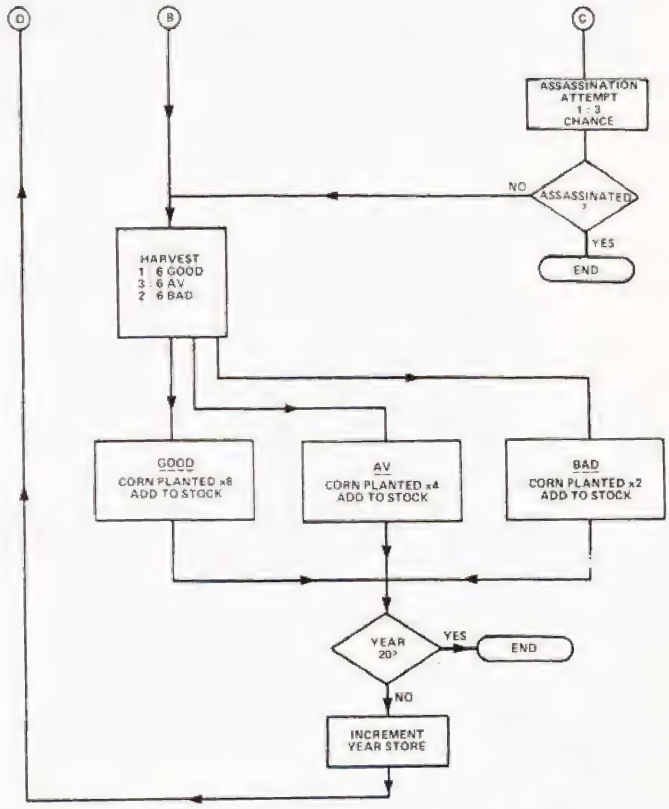
If you use more corn for food than you have people then you will have a population increase in the following year, a surplus attracts people.

Program Notes

The program is designed to run on a standard NASCOM under B–Bug monitor. Although no originality can be claimed for the idea it is possibly the first time this simulation has been attempted on such a small machine.







The three flowcharts, the divisions are to make for easier understanding.

Locations Of Messages, Sub-Routines, Stores & Data

```
INIT. INFO          0FCA– 00 10 00  0FCD 00 50 00  0FD0 00 02 00
BUFFER STORE        0FB0 – FC9
YEAR STORE          0FAF
TITLE          0F9F ***–KINGDOMS–***
TEST                0F94 – F9E
SUBTRACT            0F88 – F93
X2                  0F7A – F87
ADD                 0F63 – F79
÷2                  0F51 – F6D
INPUT DATA          0F3B – F50
MSGE 1         0F1F EF– –HOW–MANY–SACKS–OF–CORN–00 C9
MSGE 2         0F11 EF TO–PLANT?– –00 C9
MSGE 3         0F03 EF FOR–FOOD?– –00 C9
MSGE 4         0EFA EF GAINED 00 C9
MSGE 5         0EF3 EF LOST 00 C9
MSGE 6         0EE9 EF STARVED 00 C9
MSGE 7         0ECE EF IF– –ASSASSINATION–ATTEMPT–00 C9
MSGE 8         0EC9 EF UN 00 C9
MSGE 9         0EBB EF SUCCESSFUL 00 C9
MSGE 10        0EB1 EF HARVEST 00 C9
```

Note " – " indicates space character.

```
0FAF      –     YEAR NO.
0FB0      H
  1       L     NO OF PEOPLE
  2
  B3      H
  4       L     SACKS OF CORN
  5
  B6      H
  7       L     ACRES OF GROUND
  8
  B9      H
  A       L     AMOUNT OF CORN
  B             FOR PLANTING
  BC      H
  D       L     AMOUNT OF CORN
  E             FOR FOOD
0FBF      H
  C0      L     W/S 1
  1
  C2      H
  3       L     W/S 2
  4
  C5      H
  6       L     W/S 3
  7
  C8            RANDOM W/S 1
  C9            RANDOM W/S 2
```

The Program Listing

```
START    0C50  EF 1E 00          CLEAR SCREEN
           53  21 9F 0F  LD HL 0F9F  ADDRESS OF TITLE
           56  11 D7 0B  LD DE 0BD  SCREEN LOCATION
           59  01 10 00  LD BC 0010  LENGTH
           5C  ED B0     LDIR      COPY TITLE TO TOP LINE
           5E  3E 01     LDA 01    LD YEAR STORE WITH 1
         0C60  32 AF 0F  LD(0FAF)A
           63  11 B0 0F  LD DE 0FB0  START OF BUFFER
           66  2E CA     LD L CA   START OF INIT. INFO.
           68  0E 09     LDC 09    LENGTH
           6A  ED B0     LDIR      COPY INIT. INFO. INTO BUFFER
RESTART    6C  21 AF 0F  LD HL 0FAF  YEAR STORE ADDRESS
           6F  01 02 01  LD BC 0102  FOR CDA CALL
         0C72  EF                  TEXT
               1F 1F 1F            3 LINE FEEDS
               ––YEAR              (– = SPACE)
               00                  EOT
           7D  11 91 0B  LD DE 0B91  SCREEN POSITION
         0C80  CD C6 04  CALL CDA  DISPLAY YEAR
           83  EF                  TEXT
               1F 1F               2 LINE FEEDS
               ––NUMBER            (– = SPACE)
               –OF–PEOPLE
               00                  EOT
         0C99  11 9D 0B  LD DE 0B9D  SCREEN POSITION
           9C  D5        PUSH DE   SAVE IT
           9D  01 02 03  LD BC 0302  FOR CDA CALL
         0CA0  C5        PUSH BC   SAVE IT
           A1  CD C6 04  CALL CDA  DISPLAY NUMBER OF PEOPLE
           A4  EF                  TEXT
               1F                  LINE FEED
               ––SACKS             (– = SPACE)
               –OF–CORN
               00                  EOT
         0CB6  C1        POP BC
           B7  D1        POP DE    RESTORE REG'S
           B8  D5        PUSH DE
           B9  C5        PUSH BC
           BA  CD C6 04  CALL CDA  DISPLAY SACKS OF CORN
         0CBD  EF                  TEXT
               1F                  LINE FEED
               –ACRES–OF           (– = SPACE)
               –GROUND
               00                  EOT
         0CD1  C1        POP BC    RESTORE REG'S
           D2  D1        POP DE
           D3  CD C6 04  CALL CDA  DISPLAY ACRES OF GROUND
           D6  EF 1F 1F 00         2 LINE FEEDS
PLANT      DA  CD 1F 0F  CALL MSGE 1
           DD  CD 11 0F  CALL MSGE 2
         0CE0  21 B9 0F  LD HL 0FB9  START OF 'CORN FOR
                                     PLANTING STORE
           E3  CD 3B 0F  CALL 'INPUT  INPUT CORN FOR PLANTING
                         DATA'
           E6  11 B5 0F  LD DE 0FB5  LOW END 'SACKS OF CORN'
                                     STORE
           E9  2E BB     LDL BB      LOW END 'CORN FOR
                                     PLANTING
           EB  CD 94 0F  CALL 'TEST'  SEE IF ENOUGH CORN
           EE  38 EA     JRC 'PLANT'  IF NOT, ASK AGAIN
         0CF0  2E B0     LDL B0      HIGH END 'NO OF PEOPLE'
                                     STORE
           F2  1E BF     LDE BF      HIGH END W/S 1
           F4  0E 03     LDC 03      LENGTH
           F6  ED B0     LDIR        COPY NO. PEOPLE INTO W/S 1
           F8  EB        EXDE HL
           F9  CD 7A 0F  CALL 'X2'   W/S 1 = 2 X NO. OF PEOPLE
           FC  1E C1     LDE C1      LOW END W/S 1
           FE  2E BB     LDL BB      LOW END 'CORN FOR
                                     PLANTING'
         0D00  CD 94 0F  CALL TEST   SEE IF ENOUGH PEOPLE
           03  38 D5     JRC 'PLANT'  IF NOT, ASK AGAIN
           05  2E B6     LDL B6      HIGH END 'ACRE OF GROUND'
                                     STORE
           07  1E BF     LDE BF      HIGH END W/S 1
           09  0E 03     LDB 03      LENGTH
           0B  ED B0     LDIR        COPY 'ACRES OF GROUND'
                                     INTO W/S 1
           0D  EB        EXDE HL
           0E  CD 7A 0F  CALL 'X2'(1)
         0D11  CD 7B 0F  CALL 'X2'(2)
           14  CD 7B 0F  CALL 'X2'(2)  W/S 1 = 8 X ACRES OF GROUND
           17  1E C1     LDE C1      LOW END W/S 1
           19  2E BB     LDL BB      LOW END 'CORN FOR
                                     PLANTING'
           1B  CD 94 0F  CALL TEST   SEE IF ENOUGH GROUND
           1E  38 BA     JRC 'PLANT'  IF NOT, ASK AGAIN
         0D20  1E B5     LDE B5      LOW END ' SACKS OF CORN'
           22  2E BB     LD L BB     LOW END ' CORN FOR
                                     PLANTING'
           24  CD 88 0F  CALL        SUBTRACT CORN FROM TOTAL
                         'SUBTRACT'
FOOD     0D27  CD 1F 0F  CALL'MSGE1'
           2A  CD 03 0F  CALL'MSGE3'
           2D  2E BC     LDL BC      HIGH END ' CORN FOR FOOD'
                                     STORE
           2F  CD 3B 0F  CALL 'INPUT  INPUT CORN FOR FOOD
                         DATA'
         0D32  11 B5 0F  LD DE 0FB5  LOW END 'SACKS OF CORN'
                                     STORE
           35  2E BE     LD L BE     LOW END ' CORN FOR FOOD'
                                     STORE
           37  D5        PUSH DE     SAVE REGISTERS
           38  E5        PUSH HL
           39  CD 94 0F  CALL 'TEST'  SEE IF ENOUGH CORN
           3C  E1        POP HL      RESTORE
           3D  D1        POP DE
           3E  38 E7     JRC 'FOOD'  IF NOT, ASK AGAIN
         0D40  CD 88 0F  CALL        IF YES, SUBTRACT CORN FROM
                         'SUBTRACT'  TOTAL

               CHECK FOR LAND INCREASE/DECREASE

         0D43  1E BF     LDE BF      HIGH END W/S 1
           45  2E B9     LDL B9      HIGH END 'CORN PLANTED'
           47  0E 03     LDC 03      LENGTH
           49  ED B0     LDIR        COPY CORN PLANTED INTO
                                     W/S 1
           4B  2E BF     LDL BF      HIGH END W/S 1
           4D  CD 51 0F  CALL ÷2
         0D50  CD 51 0F  CALL ÷2
           53  CD 51 0F  CALL ÷2     W/S 1 = CORN PLANTED ÷8 =
                                     ACRES PLANTED
           56  1E C2     LDE C2      HIGH END W/S 2
           58  2E B6     LDL B6      HIGH END 'ACRES OF GROUND'
           5A  0E 03     LDC 03      LENGTH
           5C  ED B0     LDIR        COPY 'ACRES OF GROUND' IN
                                     W/S 2
           5E  2E C2     LDL C2      HIGH END W/S 2
         0D60  CD 51 0F  CALL ÷2     W/S 2 = ½ 'ACRES OF GROUND'
           63  1E C5     LDE C5      HIGH END W/S 3
           65  2E C2     LDL C2      HIGH END W/S 2
           67  0E 03     LDC 03      LENGTH
           69  ED B0     LDIR        COPY W/S 2 INTO W/S 3
           6B  CD 51 0F  CALL ÷2     W/S 3 = ¼ ACRES OF GROUND
           6E  1E C4     LDE C4      LOW END W/S 2
         0O70  2E C7     LDL C7      LOW END W/S 3
```

```
          72   CD 6E 0F     CALL 'ADD'    W/S 2 = 75% OF 'ACRES OF
                                          GROUND'
          75   CD 94 0F     CALL TEST     COMPARE 'ACRES PLANTED'
                                          WITH 75% 'ACRES OF GROUND'
                                          C = 0   ADD 25%
                                          C = 1   SUB 25%
       0D78   F5           PUSH AF       SAVE FLAGS
              EF                         TEXT
              1F 1F 1F 1F                4 LINE FEEDS
              --ACRES-                   (- = SPACE)
              00
          87   2E C5       LDL C5        HIGH END W/S 3
          89   11 9A 0B    LD DE 0B9A    SCREEN POSITION
          8C   01 02 03    LD BC 0302    FOR CDA
          8F   CD C6 04    CALL CDA      OUTPUT INCREASE/DECREASE
       0D92   2B           DEC HL        HL = LOW END W/S 3
          93   11 B8 0F    LD DE 0FB8    LOW END 'ACRES OF GROUND'
          96   F1          POP AF        RESTORE FLAGS
          97   38 08       JRC 'DEC'     IF C, SUB 25%, IF NOT ADD 25%
          99   CD FA 0E    CALL MSGE 4
          9C   CD 6E 0F    CALL 'ADD'
          9F   18 06       JR            SKIP DEC
DEC    0DA1   CD F3 0E     CALL MSGE 5
          A4   CD 88 0F     CALL'SUBTRACT'

                    CHECK FOR PEOPLE STARVED/GAINED

       0DA7   2E B0        LDL B0        HIGH END 'NO OF PEOPLE'
          A9   1E BF        LDE BF        HIGH END W/S 1
          AB   01 03 00     LD BC         LENGTH
          AE   ED B0        LDIR          COPY NO OF PEOPLE INTO
                                          W/S 1
       0DB0   2E BC        LDL BC        HIGH END 'CORN FOR FOOD'
          B2   CD 51 0F     CALL ÷2
          B5   CD 51 0F     CALL ÷2       'CORN FOR FOOD' NOW
                                          EQUALS PEOPLE FOOD FOR
          B8   EF                         TEXT
               1F                         LINE FEED
               --PEOPLE-                  (- = SPACE)
               00                         EOT
       0DC4   2E BE        LDL BE        LOW END 'CORN FOR FOOD'
          C6   1E C1        LDE C1        LOW END W/S 1
          C8   D5           PUSH DE       SAVE REG'S
          C9   E5           PUSH HL
          CA   CD 94 0F     CALL 'TEST'   SEE IF MORE/LESS FOOD THAN
                                          PEOPLE, C = 0 = STARVED,
                                          C = 1 = GAINED
          CD   E1           POP HL        RESTORE REG'S
          CE   D1           POP DE
          CF   F5           PUSH AF       SAVE FLAGS
       0DD0   30 11         JRNC          IF N.C. JUMP TO 'STARVED'
                'STARVED'                 OTHERWISE GAIN
          D2   EB           EXDE HL
       0DD3   CD 88 0F      CALL          TOTAL GAIN IN W/S 1
                'SUBTRACT'
          D6   CD FA 0E     CALL MSGE 4
          D9   2E BE        LDL BE        LOW END 'CORN FOR FOOD'
          DB   1E B2        LDE B2        LOW END 'NO OF PEOPLE'
          DD   CD 6E 0F     CALL 'ADD'    ADD GAIN INTO TOTAL
          E0   23           INC HL
          E1   18 0F        JR            JUMP TO DISPLAY
STARVED   E3   CD 88 0F     CALL          TOTAL STARVED IN W/S 1
                SUBTRACT
          E6   CD E9 0E     CALL MSGE 6
          E9   2E C1        LDL C1        LOW END W/S 1
          EB   1E B2        LDE B2        LOW END 'NO OF PEOPLE'
          ED   CD 88 0F     CALL          SUBTRACT 'STARVED' FROM
                SUBTRACT    TOTAL
       0DF0   2E BF        LDL BF        HIGH END W/S 1
DISPLAY   F2   11 9A 0B     LD DE 0B9A    SCREEN LOCATION
          F5   01 02 03     LD BC 0302    FOR CDA
          F8   CD C6 04     CALL CDA      DISPLAY 'STARVED' OR
                                          'GAINED'
          FB   F1           POP AF        RESTORE FLAGS
          FC   38 28        JRC           JUMP IF POP. GAIN
                'HARVEST'
```

CHECK FOR ASSASSINATION ATTEMPT AND WHETHER SUCCESSFUL

```
          FE   CD 7A 0F     CALL X2 (1)
       0P01   CD 7B 0F      CALL X2 (2)   4 X PEOPLE STARVED IN 'CORN
                                          FOR FOOD'
          04   2E C1        LDL C1        LOW END W/S 1
          06   11 B2 0F     LD DE 0FB2    LOW END 'NO OF PEOPLE'
          09   CD 94 0F     CALL TEST     IF MORE THAN 25% STARVED,
                                          C = ASSASSINATION ATTEMPT
          0C   30 18        JRNC          IF NOT, JUMP
                'HARVEST'
          0E   CD CE 0E     CALL MSGE 7
       0D11   3E 03         LDA 03        MAX FOR RND
          13   2E C8        LDL C8        LD L WITH RANDOM W/S 1
          15   CD 7A 04     CALL 'RND'    FIND RANDOM NO.
          18   FE 01        CPA 01        IF YES, SUCCESSFUL
          1A   20 04        JRNZ          IF NOT, JUMP
          1C   CD BB 0E     CALL MSGE 9
          1F   76           HALT
       0E20   CD C9 0E     CALL MSGE 8
          23   CD BB 0E     CALL MSGE 9
```

CALCULATE HARVEST

```
HARVEST   26   3E 06        LDA 06        MAX NO FOR RND
          28   2E C9        LDL C9        RANDOM W/S 2
          2A   CD 7A 04     CALL RND
          2D   2E BB        LD L BB       LOW END 'CORN FOR
                                          PLANTING'
          2F   FE 06        CPA 06        GOOD HARVEST?
       0E31   20 0F         JRNZ          IF NOT, SKIP
          33   EF                         TEXT
               1F                         LINE FEED
               --GOOD-                    (- = SPACE)
               00                         EOT
          3D   CD B1 0E     CALL MSGE 10
          40   18 12        JR 'GOOD'
          42   FE 03        CPA 03        IF LESS THAN 3, BAD HARVEST
          44   30 11        JRNC 'AV'     IF NOT, SKIP
          46   EF                         TEXT
               1F                         LINE FEED
               --BAD-                     (- = SPACE)
               00                         EOT
          4F   CD B1 0F     CALL MSGE 10
       0E52   18 06         JR 'BAD'
```

```
                                    1F                      LINE FEED
                                    --YOU'VE--
                                    SURVIVED-
                                    YOUR--20--
                                    YEAR--REIGN
                                    1F 1F 1F 1F             4 LINE FEEDS
                                    00                      EOT
                0EB0    76          HALT                    HALT

                0EB1 TO 0FD2 MESSAGES & SUBROUTINES.

                                SUB--ROUTINES

INPUT DATA
                0F3B    11 6E 0B    LD DE 0B6E      START ASCII FIELD
                  3E    01 00 03    LD BC 0300      LENGTH
                  41    CD 3E 00    CALL CHIN       GET CHAR
                  44    CD 3B 01    CALL CRT        ECHO
                  47    FE 1F       CPA 1F          CP L/FEED
                  49    28 02       JRZ             YES, SO OUT
                  4B    18 F4       JR              NO, AGAIN
                  4D    CD FC 04    CALL CAD
                  50    C9          RET
÷2
                0F51    E5          PUSH HL         SAVE HL
                  52    A7          ANDA            RESET CARRY
                  53    06 03       LDB 03          LENGTH
                  55    ED 6F       RLD             ROTATE FIRST BCD DIGIT
                  57    30 02       JRNC            SKIP IF NO CARRY
                  59    C6 0A       ADDA 0A         ADD 1010 TO A
                  5B    CB 3F       SRL             SHIFT RIGHT (÷2)
                  5D    ED 67       RRD             ROTATE BACK
                  5F    ED 67       RRD             ROTATE SECOND BCD DIGIT
                0F61    30 02       JRNC            SKIP IF NO CARRY
                  63    C6 0A       ADD A 0A        ADD 1010 TO A
                  65    CB 3F       SRL             SHIFT RIGHT (÷2)
                  67    ED 6F       RLD             ROTATE BACK
                  69    23          INC HL          POINT TO NEXT PAIR
                  6A    10 E9       DJNZ            FINISHED!
                  6C    E1          POP HL          RESTORE HL
                  6D    C9          RET             RETURN
ADD
                0F6E    A7          AND A           RESET CARRY
                  6F    06 03       LDB 03          LENGTH
                  71    1A          LDA (DE)        FIRST BCD PAIR IN A
                  72    8E          ADCA (HL)       ADD SECOND BCD PAIR INTO A
                  73    27          DAA             ADJUST
                  74    12          LD(DE)A         STORE
                  75    1B          DEL DE          POINT TO NEXT PAIR
                  76    2B          DEC HL              " -
                  77    10 F8       DJNZ            FINISHED!
                  79    C9          RET             RETURN
X2
(1)             0F7A    2B          DEC HL
(2)               7B    E5          PUSH HL         SAVE HL
                  7C    A7          AND A           RESET CARRY
                  7D    06 03       LDB 03          LENGTH
                  7F    7E          LDA(HL)         FIRST PAIR IN A
                  80    8F          ADCA A          X2
                  81    27          DAA             ADJUST
                  82    77          LD(HL)A         STORE
                  83    2B          DEC HL          POINT TO NEXT PAIR
                  84    10 F9       DJNZ            FINISHED?
                  86    E1          POP HL          RESTORE HL
                  87    C9          RET             RETURN

SUBTRACT

                0F88    A7          AND A           RESET CARRY
                  89    06 03       LDB 03          LENGTH
                  8B    1A          LDA (DE)        FIRST BCD PAIR IN A
                  8C    9E          SBC A(HL)       SUBTRACT SECOND PAIR
                  8D    27          DAA             ADJUST
                  8E    12          LD(DE)A         STORE
                  8F    1B          DEC DE          POINT TO NEXT PAIR
                  90    2B          DEC HL              " -
                  91    10 F8       DJNZ            FINISHED?
                  93    C9          RET             RETURN


TEST

                0F94    A7          AND A           RESET CARRY
                        06 03       LDB 03          LENGTH
                        1A          LD A(DE)        FIRST BCD PAIR IN A
                        9E          SBCA (HL)       SUBTRACT SECOND PAIR
                        27          DAA             ADJ
                        1B          DEC DE          POINT TO NEXT PAIR
                        2B          DEC HL              " -
                        10 F9       DJNZ            FINISHED?
                        C9          RET             RETURN

                        (IF (DE) ≥ (HL)    C = 0
                         IF (DE) < (HL)    C = 1)
```

```
GOOD            54      CD 7B 0F    CALL 'X2' (2)
AV              57      CD 7B 0F    CALL X2 (2)
BAD             5A      CD 7B 0F    CALL X2 (2)
                5D      2E BB       LDL BB          LOW END 'CORN FOR
                                                    PLANTING'
                5F      11 B5 0F    LD DE 0FB5      LOW END 'SACKS OF CORN'
              0E62      CD 6E 0F    CALL ADD        ADD HARVEST INTO STORE

                        CHECK FOR END, INC YEAR COUNT

              0E65      3A AF 0F    LD A(0FAF)      LD YEAR NO INTO A
                68      FE 20       CPA 20          20?
                6A      28 0C       JRZ 'WON'       IF YES 'WON'
                6C      C6 01       ADD A 01        INC YEAR
                6E      27          DAA
                6F      32 AF 0F    LD(0FAF)A       STORE
              0E72      31 00 10    LD SP 1000      RESTORE STACK
                75      C3 C6 0C    JP 'RESTART'    JUMP TO 'RESTART'
'WON'           78      EF                          TEXT
                79      1E                          CLR SCREEN
                        --WELL--DONE!               (- = SPACE)
```

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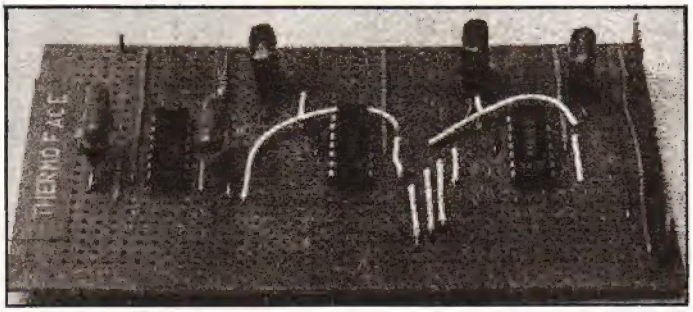
Owen Bishop

If you feel that a micro can keep an eye on your heating then you need Thermoface. Cheap, simple and effective temperature sensing to use as you like.



The Veroboarded Thermoface.

A temperature-sensitive interface puts a wide range of control and measurement functions at your disposal, even with the simplest of microprocessor systems. In this article we show how the interface can be used with the Mk 14 or the Acorn but, by modifying the programs, it may be used with most other systems besides. The interface is based on an oscillator, or astable multivibrator, the frequency of oscillation of which is dependent on temperature. In Fig.1 we see that the oscillator is built from two NAND gates, though it would be possible to use a 555 timer IC instead for this purpose. The frequency of the oscillator depends on the values of the resistors and capacitors. Since Th1 is a thermistor and its resistance decreases with an increasing temperature, the frequency of the oscillator rises as the temperature rises. The output from the oscillator is fed to a binary counting chain. If the outputs of the chain are all reset, by applying a brief high pulse to the reset inputs, the outputs then follow a binary sequence from zero (0000 0000) to 255 (1111 1111) before returning to zero and beginning all over again. If we read the state of the outputs at any time during the first sequence after resetting, we can tell how many oscillations of the multivibrator have occurred. The higher the temperature at Th1, the greater this number will be.

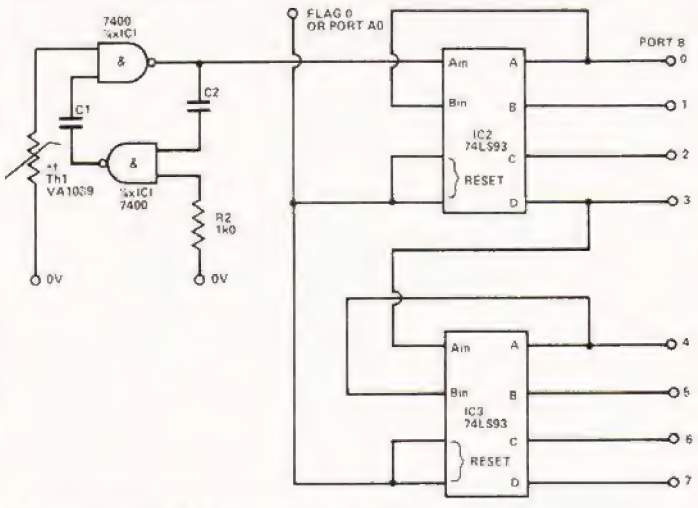


Fig.1. Circuit diagram for the thermoface unit.

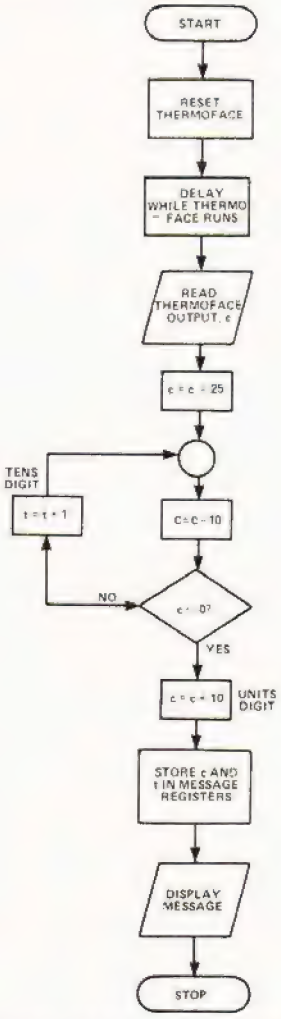


Fig.2. Flowchart for the thermoface program.

Operating Program

Fig.2 is the flow-chart of a program designed to use the thermoface for measuring temperature. Thermistor Th1 can be placed close by the microprocessor, or it may be at the end of a long pair of leads, so as to measure the temperature of some other part of the house, or perhaps in the greenhouse. The first thing the program does is to make output Flag 0 (in SC/MP) or Port A0 (in Acorn) go high, so as to reset the counting chain. All its outputs become low. Then the reset input of the counters is made low, which allows counting to begin. The chain counts the pulses received from the oscillator, and the total appears as the set of 8 counter outputs, which are fed to the microprocessor through Port B of the I/O device. This has 8 individual ports, B0 to B8, so there is just one for each of the counter output terminals. After a short period of time, determined by values loaded as part of the program, the MPU reads Port B. The count at that instant appears as an 8-bit number in accumulator. The value of this byte depends on the temperature of the thermistor. In the flow-chart, this value is called 'c'. How can we convert 'c' to a value on a known temperature scale? In certain programs this may not be necessary. For example we might

write a program for controlling the temperature of a room. If 'c' is less than, say, 20 counts, an electric heater is turned on; if 'c' is less than, 16, two heaters are turned on. If 'c' is greater than 30, an extractor fan is turned on, and if 'c' is more than 45 the fire alarm is sounded! In a program of this sort the action is taken at some given value of 'c', and we can vary the values at which action is taken at some given value incorporated in the program. If we want to relate action to actual temperature values on the Celsius (or other) scale, we need to calibrate the system so that we know what value of 'c' corresponds with what temperature in degrees Celsius. We write a program that allows the MPU to calculate temperature from the value it reads from thermoface. This program could be complicated, and is sure to be so if a large range of temperature is to be covered. Fortunately there is a simple way out that is very satisfactory for many purposes.

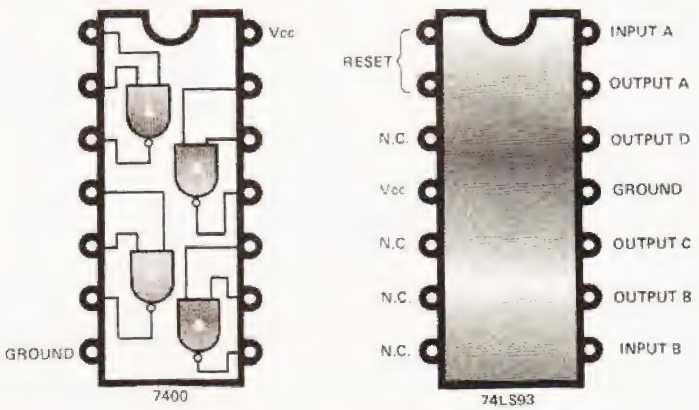
Taking The Temperature

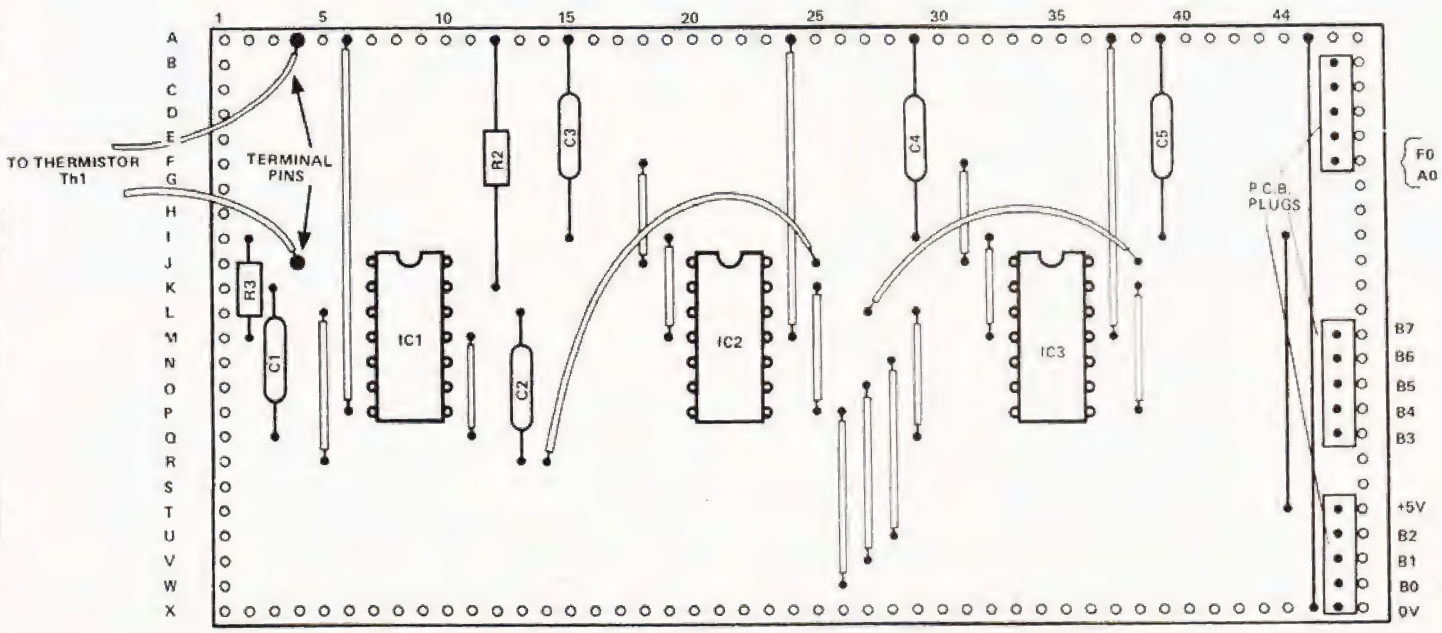
We can operate thermoface so that for each degree rise in temperature, the value of 'c' increases by 1. For the circuit used here, we find that if, during a given period of time, the counter reaches a value of 35 when Th1 is at 10°C, then during the same period it reaches a value of 45 when Th1 is at 20°C. So over the range 10°C to 20°C, as well as a little above and below that range, we only have to subtract 25 from 'c' and we have calculated the temperature in degrees Celsius. This is something that the microprocessor can easily do, and this is the first stage of the calculations performed in this program. Next, the value of 'c', which now is the temperature, but is in binary form, has to be converted to decimal. A loop subtracts 10 repeatedly from 'c', until it goes negative. Each time 10 is subtracted, a counter, 't', keeps account of the number of tens. The final subtraction leaves 'c' negative and when 10 is added to this result we obtain the units digit of the temperature. The values of 't' (tens) and 'c' (units) are then incorporated in a message which displays the temperature value.

Construction Of Thermoface

The layout is not critical, so Fig.3 need be taken only as a guide. First assemble the oscillator circuit (IC1, Th1, R2, C1 and C2). The oscillator uses only 2 gates of the 4 gates present in IC1; the inputs of the two unused gates are wired together and connected to the 5 V line by way of R3. For use with the Mk 14 program, C1 and C2 should have the value 220n. For use with Acorn a higher value is preferred, for example 680n or even 1u0. If you connect an earphone or earplug across the output of the oscillator (R14, to the ground line, strip A) you should be able to hear a tone that varies in pitch as the temperature at Th1 is changed. Low-power Schottky ICs were chosen for the counter chain so as to economise on supply current. Note that although for most TTL ICs the pin connections of standard and LS types *are* identical, the connections of the 74LS93 are very different from those of the 7493. If you want to use a 7493, the wiring must be modified to suit.

Counter ICs are prone to triggering by stray pulses, so the supply rails are decoupled by capacitors C3 to C5, placed as indicated between the three ICs. To reset these counters both reset inputs are made high, their terminals





COPPER STRIPS CUT BENEATH BOARD AT
J8, K8, L8, M8, O8, P8 (NOT N8),
J16, K16, L16, M16, N16, O16, P16, Q16, R16,
J21, K21, L21, M21, O21, P21,
J30, K30, L30, M30, N30, O21, P21,
J30,
J34, K34, L34, M34, N34, O34, P34,
M40.

SOLDER BLOBS BENEATH BOARD
JOIN ADJACENT STRIPS AT
K7 & L7, M7 & N7, I10 & J10,
K10 & L10, N10 & O10, J20 & K20,
J33 & K33, L42 & M42.

Fig.3. Stripboard layout for thermoface.

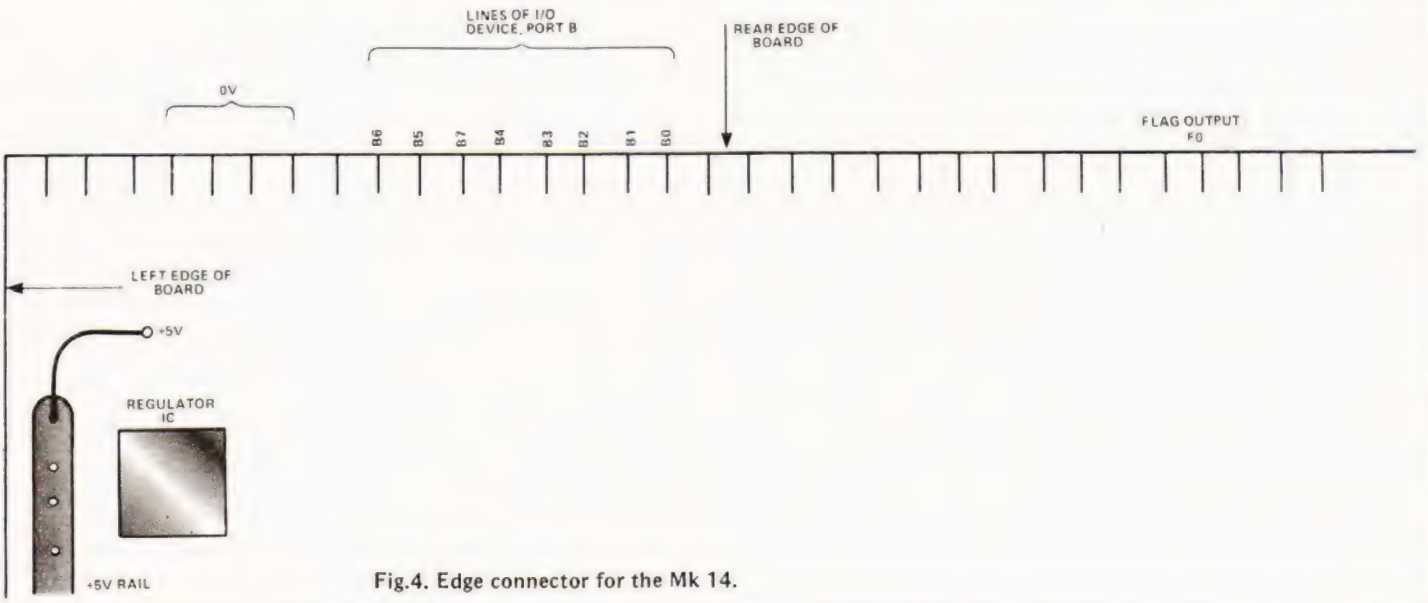


Fig.4. Edge connector for the Mk 14.

being joined by solder blobs beneath the board. Remember that the separate 'A' counter in each IC must be joined to the other three counters (connected internally) by wiring A output to B input, as shown. To test the circuit, connect an earphone to each counter output in turn; you should hear notes that are successively an octave lower as you proceed along the chain.

Connections To The Microcomputer

For Mk 14, use an edge connector that fits on the board, and take wires from this to 3 PCB sockets which plug on to the plugs on the thermoface board, Fig.4 shows where connections are to be made. For Acorn, follow the plan shown in Fig.5.

Setting Up The Programs

Program A gives a temperature reading every time you press 'G,G'. To set up this program we have to arrange that the microprocessor waits exactly long enough for the counter to register '35' when the temperature of Th1 is 10°C. You can

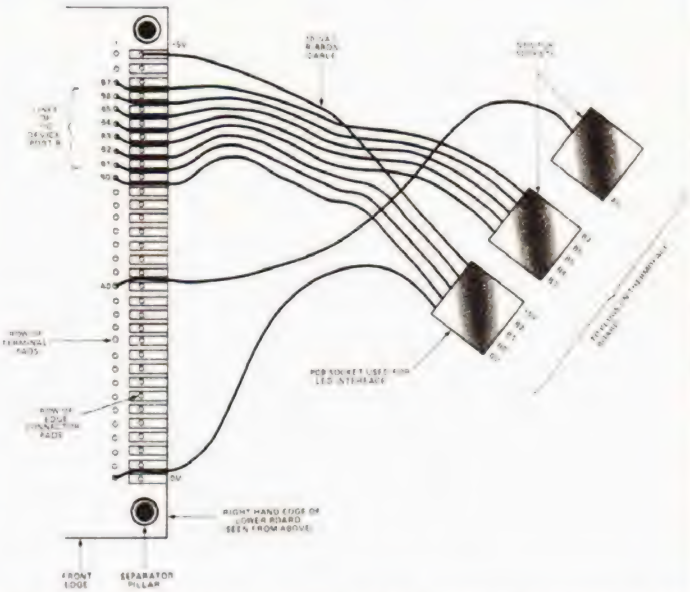


Fig.5. Connections to the Acorn. Do not solder to the pads on the edge connector.

PARTS LIST

RESISTORS All ¼W, 5%
Th1 ..... Thermistor type VA1039
R2,3 ..... 1k0

CAPACITORS
C1,C2 ..... 220n (for SC/MP) or 680n (for 6502) polyester
C3–5 ..... 100n polyester

SEMICONDUCTORS
IC1 ..... 7400 quad 2-input NAND
IC2,3 ..... 74LS93 4-bit binary counter

MISCELLANEOUS
Strip-board, PCB plugs, 5-way, 0.1" spacing; PCB sockets, 5-way, 0.1" spacing, terminal pins.

immerse the thermistor in a glass of water kept at that temperature, but if your room is at some steady temperature in the 10–20 degree range, use an ordinary thermometer to read the value and then alter the data at 004C until the display shows that temperature every time you press 'G,G'. The program uses the '½ WAIT' subroutine in monitor to allow the sampling period to be adjusted more precisely. If you find that you have trouble in getting the display to show exactly the figure required, this could be because an increase of 004C from 20 to 21 increases the count from, say 36 to 38, and it is not possible to get the required value 37. If this is a problem, use capacitors of higher value, so that the required sampling time is longer and it becomes possible to adjust the sampling period in smaller steps. Depending on the components used, you may get better results if 0059 is altered to E6 or to E8.

Program B displays the temperature for about 1 second, then jumps back to the beginning to measure the

temperature again. The display flickers about once a second and, if temperature has changed, a new value appears. This is set up in the same way as described above; for coarse adjustment of the timing, alter the value at 0F3C and for fine adjustment alter that at 0F3A. The values given are suited for capacitors of 220n each.

Variations

This basic interface can be put to many uses. By using relays, as described in Part 2 (March 1980), you can switch any number of different thermistors into circuit in turn and measure temperatures in different parts of the house, as well as outdoors. It is a common experience that on cold days the central-heating thermostat needs altering to a higher setting to obtain the usual degree of comfort indoors. By monitoring both indoor and outdoor temperatures, and by suitable programming of the data, the microprocessor can do the resetting for you. By monitoring outdoor temperatures at regular intervals, say every quarter of an hour, the system can predict probable temperatures a few hours ahead and give you early warning of frost danger. Most of these applications require very little in the way of hardware, and rely more on your ingenuity as a programmer. At least, here's a chance to develop a *useful* program instead of yet another game.

Would you like a thermometer that reads to a tenth of a degree? Thermoface can cope with this too. Simply decrease the value of the capacitors to one tenth so that the oscillator runs ten times faster. You will also need to adapt the programs. The sampling time will be about the same length but the reading, 'c', represents tenths of a degree, after the new constant value of 250 has been subtracted from it. For example, if the temperature is 14.3°C, the reading obtained is 393. To represent this in binary requires nine digits 1 1000 1001, so the counter will have run all the way to 255 and have started again from zero. If the temperature is known to be between 10°C and 26°C, we can assume in the program that the ninth digit is a 1, and calculate accordingly. To subtract 250 (1111 1010), we add the two's complement, 00000101 plus 1 which is 0000 0110, this is coded in the program as 06. From that point on you will need to revise the program to cope with a three digit answer and a decimal point in the display (code 80), but this is just a matter of extending the principles of the programs already given.

In connection with temperature prediction, or the control of room temperatures it is often useful for the microprocessor to know what time of day it is. It needs a real-time clock. This is a peripheral which will be described in a forthcoming article in this series.

Program A: Operates THERMOFACE and displays temperature, in degrees Celsius. For 6502, in Acorn.

```
0030  A9 00        LDA#00'     defines all Port
0032  8D 21 09     STA at 0DB  B as inputs
0035  A9 01        LDA#01'     defines Port A0
0037  8D 22 09     STA at 0DA  as an output
003A  A9 00     A : LDA#00'     clears register t
003C  85 20        STA Z20     (0020)
003E  8D 10 09     STA at Port A0, high output
                   resets THERMOFACE
0041  A0 10        LDY#10'     delay while
0043  20 CD FE  B : JSR to WAIT reset takes
0046  88           DEY counting effect
                   down
0047  10 FA        BPL to B, if Y
                   not zero
0049  8D 00 09     STA at Port A0, low output lets
                   THERMOFACE run
004C  A0 20        LDY#20'
004E  20 D0 FE  C : JSR to ½ WAIT  delay while
0051  88           DEY counting  THERMOFACE
                   down          runs
0052  10 FA        BPL to C, if Y
                   not zero
0054  AD 21 09     LDA with date from Port B
                   (count, c)
0057  18           CLC
0058  69 E7        ADC#E7' (=subtract 25)
005A  18        D : CLC
005B  69 F6        ADC#F6' (=subtract 10)
005D  30 05        BMI to E, if c < 0
005F  E6 20        INC Z20 still positive, so register
                   a 'ten' at t
0061  4C 5A 00     JMP to D to check for another
                   'ten'
0064  18           CLC
0065  69 0A     E : ADC#0A' add decimal 10 to
                   restore 'units' digit
0067  AA           TAX units digit to X
0068  BD EA FF     LDA A,X 7-segt code of units
                   digit in A (from FONT)
006B  85 27        STA Z27 units code stored in
                   message string (0027)
006D  A6 20        LDX Z20 tens digit to X
006F  BD EA FF     LDA A,X 7-segt code of tens
                   digit in A (from FONT)
0072  85 26        STA Z26 tens code stored in
                   message string (0026)
0074  A2 07        LDX#07'
0076  B5 23     F : LDA Z,X23
0078  95 10        STA Z,X        display routine
007A  CA           DEX
007B  10 F9        BPL to F
007D  4C 04 FF     JMP to RESTART in monitor
0020               Register, t, for 'tens' digit
0023  00 78 48 00 00 63 39 00  Message
```

Program B: Operates THERMOFACE and displays temperature, updating reading approximately once a second. For SC/MP in Mk 14.

```
0F1D               tens digit counter, t
0F1E               counter for display, d
0F1F               counter for display delay loop, D
0F20  C4 08     A : LDI '08'   Pointer 1 to I/O
0F22  35           XPAH P1    device (0800)
0F23  C4 00        LDI '00'
0F25  C8 F7        ST at t, to reset tens counter
0F27  C4 01        LDI '01'   Pointer 2 to 'Hex
0F29  36           XPAH P2    number to seven
0F2A  C4 0B        LDI '0B'   segment' table, in
0F2C  32           XPAL P2    monitor (010B)
0F2D  C4 D0        LDI '0D'
0F2F  C8 EF        ST at D, to load counter
0F31  C4 01        LDI '01'
0F33  07           CAS make Flag 0 high to reset
                   THERMOFACE
0F34  8F 10        DLY delay while reset takes
                   effect
0F36  C4 00        LDI '00'
```

```
0F38  07           CAS make Flag 0 low to let
                   THERMOFACE run
0F39  C4 80        LDI '80' prepare   delay while
                   for delay          THERMO-
0F3B  8F 2E        DLY                FACE runs
0F3D  C1 21        LD P1+21 read data at Port B
                   (count, c)
0F3F  02           CCL
0F40  F4 E7        ADI 'E7'  (=subtract 25)
0F42  02       B : CCL
0F43  F4 F6        ADI 'F6'  (=subtract 10)
0F45  94 11        JP to C, if c ⩾ 0
0F47  02           CCL
0F48  F4 0A        ADI '0A' add decimal 10 to
                   restore 'units' digit
0F4A  01           XAE units digit to extension
                   register
0F4B  C2 80        LD P2+E 7-segt code of units
                   digit in AC
0F4D  C8 35        ST as fourth character of
                   message (0F83)
0F4F  C0 CD        LD t tens digit in AC
0F51  01           XAE t to extension register
0F52  C2 80        LD P2+E 7-segt code of tens
                   digit in AC
0F54  C8 2F        ST as third character of message
                   (0F84)
0F56  90 06        JMP to D
0F58  01       C : XAE transfer result of
                   subtraction to E
0F59  A8 C3        ILD counting number of 'tens'
0F5B  01           XAE result of subtraction
                   returned to AC again
0F5C  90 E4        JMP to B to check for another
                   'ten'
0F5E  C4 0D    D : LDI '0D'          Pointer 1 to
0F60  35           XPAH P1           display (0D00)
0F61  C4 0F        LDI '0F'          Pointer 2
0F63  36           XPAH P2           to message
0F64  C4 80        LDI '80'          address
0F66  32           XPAL P2           (0F80)
0F67  C4 08        LDI '08'
0F69  C8 B4        ST at d, ready for counting
                   display characters
0F6B  C6 01    E : LD@ P2+1 load 7-segt codes
0F6D  CD 01        ST@ P1+1 store them in display
0F6F  8F 01        DLY
0F71  B8 AC        DLD d, counting down
0F73  9C F6        JNZ to E, to display next
                   character
0F75  C4 00        LDI '00'          restore P1 to
0F77  32           XPAL P1           beginning of
                                     display
0F78  B8 A6        DLD D counting down
0F7A  9C E2        JNZ to D to repeat display
                   routine
0F7C  90 A2        JMP to A to read new
                   temperature and display it
0F80  00 39 63 00 00 48 78 00      Message
```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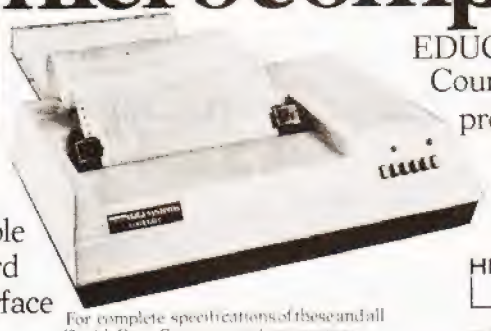

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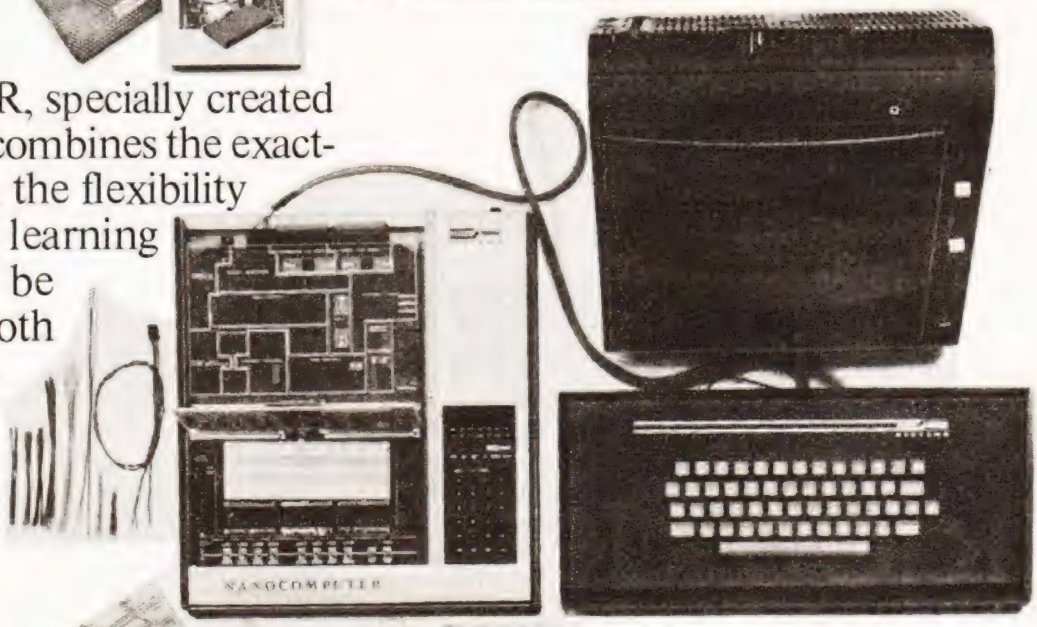

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A.P. Stephenson

Multiple choice exams represent an ideal entry point to the classroom for computers.

The multiple-choice question paper first vented its spite on thousands of luckless "volunteers" who were trained during the last World War. The traditional essay type examination was too slow, favoured those who had the ability to disguise their ignorance with high-sounding jargon and, worst of all, the marking of the exam required some degree of professionalism. A gentleman by the name of Ballard is credited with the invention of presenting a question and four answers labelled A, B, C and D ... only one of which is considered to be the "right" one. All the trainee had to do was place a cross in the "right" place. The technique was highly successful. A wide range of subjects could be covered in 100 question paper and could be marked by unskilled personnel in less than a minute by simply placing a prepared stencil over the paper. Although originally intended as a wartime expedient, the advantages were found to be so great that it has survived until the present day. The educational Establishment was naturally very critical, mumbling something like ".....training a bunch of parrots etc etc" but the seal of respectibility was finally given when technical colleges, and even universities, succumbed to the temptation. The computer is ideally situated as a tool in this area of education because it demands a minimum of keyboard interraction from the examinee. A question is flashed on the screen, demanding that ONE particular key is pressed. Traditional keyboard questions and answers suffer from the infuriating habit of marking you wrong even if a trivial spelling error is made or perhaps even an extra space.

Guiding Principles

Much of the criticism of multiple choice papers is due not to the method itself but the style of the questions. Too many of these questions are made up by small-minded individuals who often lack real knowledge of their subject and make up for it by composing, what they believe to be, "clever" tricks which are guaranteed to fool the poor student. The rules are simple:

a) keep the question short and straightforward.
b) make sure that all four of the answers are *superficially* correct.
c) the correct answer expected should be that which is more universally true.
d) don't make one of the answers absurdly wrong because this is equivalent to reducing the number of choices by one.
e) make sure you really know the correct answer yourself!

The Programs

These have been in use for some time at a MOD Training Establishment (where I slave from dawn to dusk in return for the occasional bowl of rice). MULTIPLE CHOICE PREPARATION allows anyone to enter 25 questions, each with four answers and the right answer. In addition, the time allowed and the minimum pass mark can be entered. The end result of this activity is a "Data Tape" with the precious collection of mental sadism embedded within its magnetic bosom.

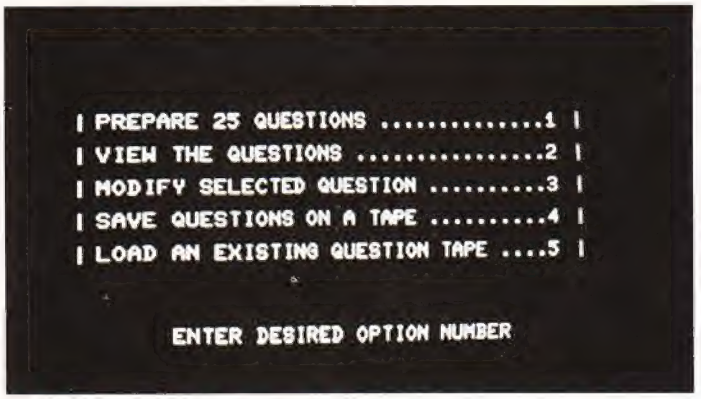
The second program, MULTIPLE CHOICE EXAM, is operated by the person being examined and begins with instructions for loading the data tape containing the questions. The questions are presented together with the four answers and the final score with percentages and a grading category appears on the screen. Should the examinee exceed the time allowed, the questions cease and the score page is presented immediately. Time lapse is given on each "page". Facilities exist during the preparation stage for producing the questions, displaying the questions, modifying them, saving them on the data tape and making additional copies from an existing tape. Subroutines are used to ensure that deficiencies in the data tape operating system (present in the "old ROMS") are corrected by suitable patching. A subroutine for treating the keyboard as an INPUT FILE is also provided to prevent the program from breaking out should the operator inadvertently press RETURN before entering a character. The preamble to the questions are written as DATA/READ statements in order that modifications to suit local conditions are easy to incorporate. It is reasonably "idiot proof" but to fit the program into an 8K PET the REM statements had to be curtailed. However, the program should be fairly straightforward to follow without them. It was written to the accompaniment of periodic curses, frequent syntax error messages and some unpleasantness between programmer and PET. As a result, the line numbers are ragged, the structure is poor...in fact its only saving grace is it works!

Application

Although the program is oriented towards the teaching profession, it could also prove useful in the home. It is educational in two senses; answering the questions which one member of the family has set with the aid of the "PREPARATION" program and vice versa. It is probably harder to write a good set of 25 questions than it is to answer them. Some of the questions may of course be disputed (or rather the particular answer which is supposed to be correct) but even this is good. Plato and his followers spent most of their life learning by arguing. Because of the possibility of dispute, facilities are provided for modifying a question. Some modifications to the program itself may be necessary in some cases. Thus the number of questions are fixed at 25 but can be changed by altering the value of "L" in line 100 of the PREPARATION program. Only those with 16K PETs however should increase L to say 50 or 100 because of the possibility of "OUT OF MEMORY ERROR". More than one copy of the question DATA tape can be made by simply using option "5" which is "LOAD AN EXISTING TAPE", insert a blank tape and then use option "4" to "SAVE QUESTIONS ON TAPE".

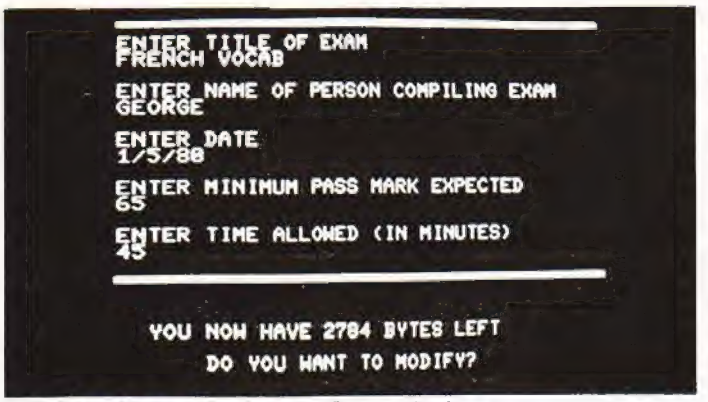
Because of the limited characters per line and number of lines on the PET screen, the following rules apply to preparing questions;

The question must be limited to TWO lines. Remember to use the SPACE key to turn the corner to the second line . . . not the RETURN key.
Each answer must be limited to one line.



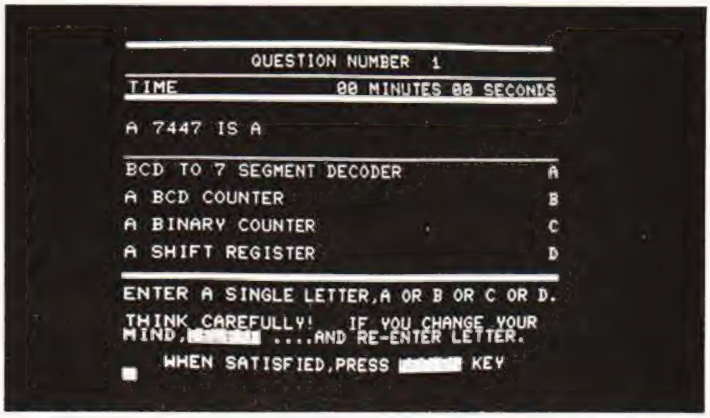
Heading frame for the preparation program.

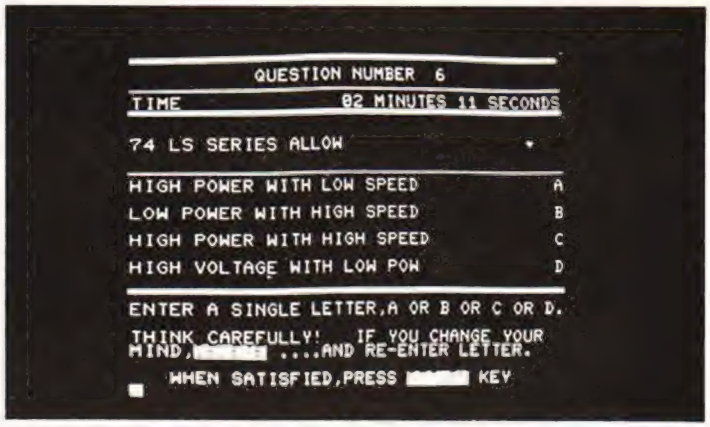
```
100 DIM A$(25,7):L=25
110 GOTO540
120 REM
130 REM *ENTER PREAMBLE TO ARRAY
140 PRINTCHR$(147):F=0
150 PRINT"8888888888888888888888888888888888888888
    88
160 PRINT"ENTER TITLE OF EXAM"
170 GOSUB1340
180 A$(0,0)=I$:PRINT:PRINT
190 PRINT"ENTER NAME OF PERSON COMPILING
    EXAM"
200 GOSUB1340
210  A$(0,1)=I$:PRINT:PRINT
220 PRINT"ENTER DATE"
230 GOSUB1340
240 A$(0,2)=I$:PRINT:PRINT
250 PRINT"ENTER MINIMUM PASS MARK
    EXPECTED"
260 GOSUB1340
270 A$(0,3)=I$:PRINT:PRINT
280 PRINT"ENTER TIME ALLOWED (IN MINUTES)
290 GOSUB1340
300 A$(0,4)=I$:PRINT:PRINT
310 PRINT"8888888888888888888888888888888888888888
    88":PRINT:PRINT
320 GOSUB 1400
330 IF F=0 THEN 130
340 F=0
350 REM *ENTER MAIN ARRAY
360 PRINTCHR$(147):M=0
370 FOR N=1 TO L
380 REM
390 FOR Q=1 TO 7
400 READ P$(Q)
410 IF Q=1 THEN PRINT P$(Q);N:A$(N,Q)=
    STR$(N): GOTO 470
430 GOSUB1340
440 PRINT
450 PRINT" ''''''''''''''''''' "
460 A$(N,Q)=I$
470 NEXT:RESTORE
480 IF M=1 THEN RETURN
490 GOSUB1400
500 IF F<>1 THEN PRINT CHR$(147):GOTO 390
510 F=0
520 PRINTCHR$(147)
530 NEXT
540 PRINTCHR$(147):PRINTTAB(240)
550 PRINT"%PREPARE 25 QUESTIONS .....1'
560 PRINT
570 PRINT"%VIEW THE QUESTIONS .....2'
580 PRINT
590 PRINT"%MODIFY SELECTED QUESTION ....3'
600 PRINT
610 PRINT"%SAVE QUESTIONS ON A TAPE .....4'
620 PRINT
630 PRINT"%LOAD AN EXISTING QUESTION TAPE
    .....5'          ":PRINT:PRINT:PRINT
640 PRINT" ENTER DESIRED OPTION NUMBER
650 GET K$:IF K$=" " THEN 650
660 IF VAL(K$)<1 OR VAL (K$)>5 THEN 650
670 ON VAL(K$) GOTO120,1060,980,680,1220
680 REM *WRITE PREAMBLE TO TAPE
690 PRINTCHR$(147):PRINTTAB(120)
700 GOSUB1460
710 PRINT"IT IS ASSUMED YOU HAVE A BLANK
    TAPE IN":PRINT
```



Initial data being entered under 'Preparation'.

```
720 PRINT"THE CASSETTE;IT IS REWOUND; AND
    THE TAPE":PRINT
730 PRINT" MOTOR IS SWITCHED OFF!"PRINT:
    PRINT:PRINT
740 PRINT" BE PATIENT!":PRINT:PRINT:PRINT
750 PRINT" OBEY INSTRUCTIONS,":PRINT:PRINT:
    PRINT
760 GOSUB1290
770 PRINTCHR$(147):PRINTTAB(240)
780 GOSUB1460
790 OPEN 1,1,2
800 FOR Q=0 TO 4
810 PRINT#1,A$(0,Q)
820 NEXT
830 REM *WRITE TEXT COMPLETE
840 FOR N=1 TO L
850 FOR Q=1 TO 7
860 PRINT#1,A$(N,Q)
870 NEXT:NEXT
880 GOSUB1480:REM*PREPARE TO CLOSE FILE
890 CLOSE 1
900 GOSUB1290
910 PRINTCHR$(147):PRINTTAB(240)
920 PRINT" DATA NOW ON TAPE FILE
930 PRINT" 8888888888888888888888":PRINT:PRINT:
    PRINT:PRINT
940 GOSUB1290
950 GOTO540
960 REM *MODIFY SELECTED QUESTION
970 REM
980 PRINTCHR$(147):PRINTTAB(240):M=1
990 PRINT"ENTER QUESTION NUMBER TO BE
    MODIFIED":PRINT
1000 GOSUB1340
1010 N=VAL(I$):PRINTCHR$(147)
1020 GOSUB380: REM *ENTER MAIN ARRAY
     AS A 'SUB R'
1030 GOTO540
1040 REM *DISPLAY QUESTIONS
1050 REM
1060 PRINTCHR$(147)
1070 FOR N=1 TO L
1080 PRINTCHR$(147)
1090 PRINT"8888888888888888888888888888888888888888
     88
1100 FOR Q=1 TO 7
1110 IF Q=1 THEN PRINT"QUESTION NUMBER":
1120 PRINT A$(N,Q)
1130 PRINT" ''''''''''''''''''' "
1140 NEXT
1150 PRINT:PRINT:PRINT
1160 GOSUB1290
1170 PRINT
1180 NEXT
1190 GOTO540
1200 REM *LOAD NEW TAPE
1210 REM
1220 PRINTCHR$(147):PRINTTAB(240)
1230 PRINT" 1. PLACE THE DATA TAPE IN
     CASSETTE":PRINT
1240 PRINT" 2. REWIND IT":PRINT
1250 PRINT" 3. SWITCH THE MOTOR OFF":PRINT:
     PRINT:PRINT
1260 GOSUB1290
1270 PRINTCHR$(147)
1280 GOTO1650
1290 REM *SUB ROUT PRESS-KEY
1300 PRINT" PRESS ANY KEY WHEN READY TO
     PROCEED"
```



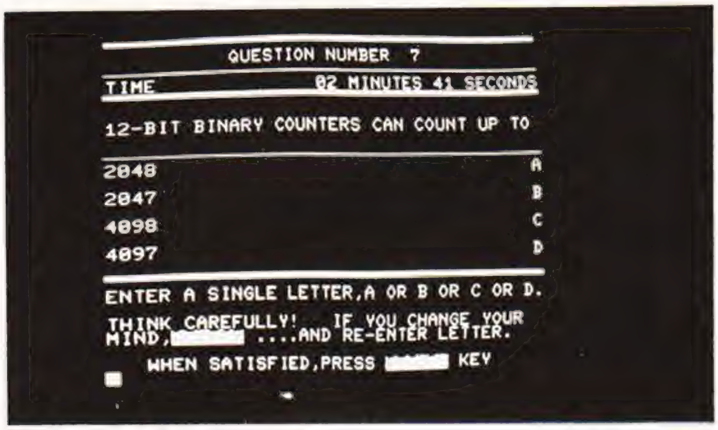


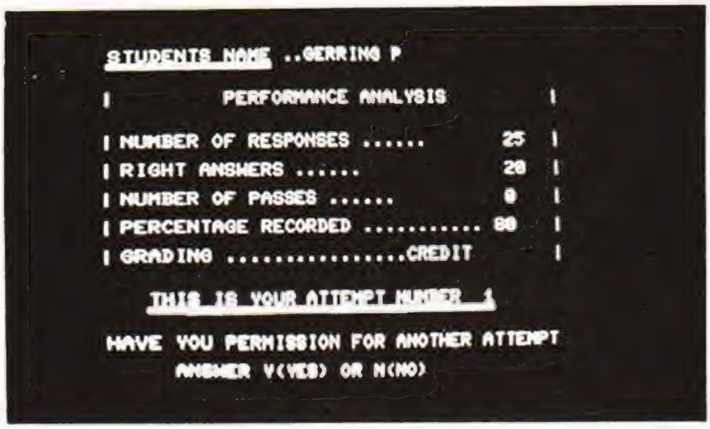
These photos show a number of stages in the course of an exam on 7400 series TTL.

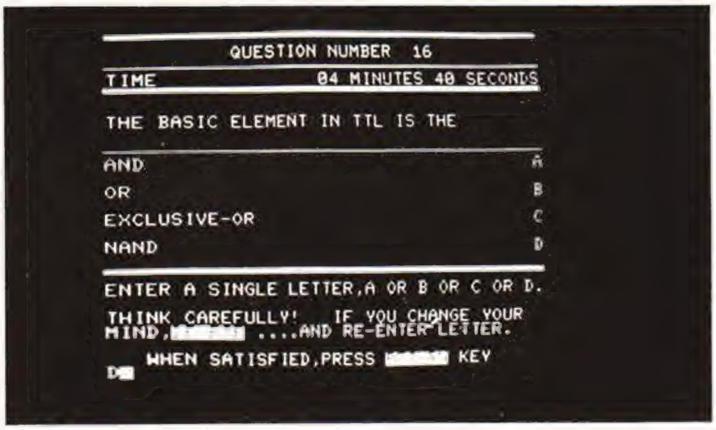
```
1310 GET W$: IF W$ = " " THEN 1310
1320 RETURN
1330 REM
1340 REM * CP INPUT
1350 OPEN 1,0
1360 INPUT # 1,I$
1370 IF I$ = " " THEN 1360
1380 CLOSE 1
1390 RETURN
1400 REM *SR SATISFIED?
1410 PRINT" YOU NOW HAVE"FRE(0)"BYTES
     LEFT":PRINT
1420 PRINT" DO YOU WANT TO MODIFY?
1430 GOSUB1340
1440 IF I$ < >"YES" THEN F = 1
1450 RETURN
1460 REM *PREPARE TO OPEN 'WRITE' FILE
1470 POKE 243,122:POKE 244,2:RETURN
1480 REM *SR PREPARE TO CLOSE WRITE
1490 IF PEEK(625) > 180 THEN 1510
1500 RETURN
1510 POKE 59411,53:T8 = TI
1520 IF TI-T8 < 6 THEN 1520
1530 POKE 59411,61
1540 RETURN
1550 DATA" QUESTION NUMBER "
1560 DATA"ENTER THE QUESTION"
1570 DATA"ENTER THE FIRST ANSWER (A)"
1580 DATA"ENTER THE SECOND ANSWER (B) "
1590 DATA"ENTER THE THIRD ANSWER (C) "
1600 DATA"ENTER THE FOURTH ANSWER (D) "
1610 DATA"WHICH ANSWER A,B,C,D IS CORRECT
     ?"
1620 GOSUB1340
1630 REM*TEST TAPE RUNBACK
1640 PRINTCHR$(147)
1650 OPEN 1,1,0
1660 PRINT "WARNING!TAPE DELIVERY IS IN
     BURSTS.":PRINT:PRINT
1670 PRINT"JUST HAVE PATIENCE AND OBEY
     ORDERS":PRINT:PRINT:PRINT
1680 FOR Q = 0 TO 4
1690 INPUT # 1,A$(0,Q)
1700 PRINT A$(0,Q)
1710 NEXT
1720 GOSUB1290
1730 FOR N = 1 TO L
1740 FOR Q = 1 TO 7
1750 INPUT # 1,A$(N,Q)
1760 PRINT A$(N,Q)
1770 NEXT
1780 PRINT
1790 NEXT
1880 CLOSE 1
1810 GOSUB1290
1820 PRINTCHR$(147):PRINTTAB(240)
1830 PRINT" TAPE DATA IS NOW LOADED
1840 PRINT" 88888888888888888888888":PRINT:
     PRINT:PRINT:PRINT
1850 GOSUB1290
1860 GOTO540
```

The 'Preparation' program listing.

```
100 DIM A$(25,7)
110 L = 25:G = 1:H = 3600
120 PRINTCHR$(147)
130 PRINT" MULTIPLE CHOICE EXAM.
140 PRINT
150 PRINT" THIS PROGRAM REQUIRES A DATA
    TAPE WITH":PRINT
160 PRINT" THE QUESTIONS STORED ON IT !":
    PRINT:PRINT
170 PRINT" 1. PLACE THIS TAPE IN THE
    CASSETTE":PRINT
180 PRINT" 2. REWIND IT":PRINT
190 PRINT" 3. SWITCH THE MOTOR OFF":PRINT
    :PRINT
200 GOSUB1300
210 PRINTCHR$(147):PRINT:PRINT
220 PRINT"8888888888888888888888888888888888888
    88
230 PRINT"OBEY THE FOLLOW AND RELAX FOR A
    BIT!"
240 PRINT"8888888888888888888888888888888888888
    88":PRINT:PRINT:PRINT:PRINT
250 REM
260 OPEN 1,1,0
270 FOR Q = 0 TO 4
280 INPUT # 1, A$(0,Q)
290 GOSUB1340
300 NEXT
310 REM *INPUT MAIN DATA
320 FOR N = 1 TO L
330 FOR Q = 1 TO 7
340 INPUT # 1,A$(N,Q)
350 GOSUB1340
360 NEXT:NEXT
370 CLOSE 1
380 PRINTCHR$(147):PRINTTAB(240)
390 PRINT" THE QUESTIONS ARE NOW LOADED
400 GOSUB1300
410 PRINTCHR$(147):PRINT:PRINT
420 PRINT"ENTER YOUR NAME AND INTITIALS
430 GOSUB1440
440 N$ = I$:PRINT
450 PRINT"8888888888888888888888888888888888888
    88":PRINT
460 PRINT"WHEN THE QUESTIONS APPEAR, KEY
    EITHER":PRINT
470 PRINT"A,B,C, OR D. OTHER KEYS IMPLY
    PASS" :PRINT:PRINT
480 GOSUB1300
490 PRINTCHR$(147)
500 P = 0:R = 0:N1 = 0
510 PRINT" 25 MULTIPLE CHOICE QUESTIONS
520 PRINT
```








```
530 PRINT
540 PRINT" LIBRARY TITLE ..";A$(0,0)
550 PRINT
560 PRINT"DATE OF COMPILATION..";A$(0,2)
570 PRINT
580 PRINT" COMPILED BY ..";A$(0,1)
590 PRINT
600 PRINT" MINIMUM PASS MARK ..";A$(0,3)
610 PRINT
620 PRINT"TIME ALLOWED..";A$(0,4);
    "MINUTES"
630 PRINT
640 PRINT
650 PRINT" TIME CLOCK STARTS
660 PRINT:PRINT:PRINT:PRINT
670 GOSUB1300
680 TI$="000000"
690 REM
700 FOR N=1 TO L
710 PRINTCHR$(147)
720 PRINT"888888888888888888888888888888888888888
    88
730 PRINT" QUESTION NUMBER ";N
740 PRINT" .................................. "
750 PRINT"TIME ";:GOSUB1380
760 PRINT"888888888888888888888888888888888888888
    88":PRINT
770 FOR Q=2 TO 7
780 IF Q=7 THEN 810
790 K=62+Q:IF Q=2 THEN K=0
800 PRINTA$(N,Q)TAB(38)CHR$(K):PRINT
    :GOTO900
810 PRINT"888888888888888888888888888888888888888
    88
820 PRINT"ENTER A SINGLE LETTER, A OR B OR
    C OR D.":PRINT
830 PRINT"THINK CAREFULLY! IF YOU CHANGE
    YOUR
840 PRINT"MIND,DELETE....AND RE-ENTER
    LETTER ":PRINT
850 PRINT" WHEN SATISFIED, PRESS RETURN2
    KEY
860 GOSUB1440
870 IF I$=A$(N,7) THEN R=R+1
880 IF I$<>"A"AND I$<>"B" AND I$<>"C"
    AND I$<>"D" THEN N1=N1+1
890 GOTO910
900 IF Q=2 THE PRINT" .................... "
910 NEXT
920 REM *TIME OUT
930 IF TI>H *VAL(A$(0,4)) THEN 960
940 NEXT
950 GOTO1000
960 PRINTCHR$(147):PRINT:PRINT:PRINT:PRINT
970 PRINT" 8888888888888888888888888888888
    "PRINT:PRINT:PRINT
990 GOSUB1300
1000 PRINTCHR$(147)
1010 PRINT"STUDENTS NAME ..";N$
1020 PRINT"8888888888888
1030 P=R*100/L :P=INT(10*P+.5)/10
1040 IF P<VAL(A$(0,3))THEN G$="FAIL"
1050 IF P>=VAL(A$(0,3)) AND P<80 THEN
     G$="PASS"
1060 IF P>80 AND P<90 THEN G$="CREDIT"
1070 IF P>90 THEN G$="DISTINCTION"
1080 PRINT
1090 PRINT"% PERFORMANCE ANALYSIS
1100 PRINT
1110 PRINT
1120 PRINT"%NUMBER OF RESPONSES ......"
     TAB(33)N-1;TAB(38)"
1130 PRINT
1140 PRINT"%RIGHT ANSWERS ......"
     TAB(33)R;TAB(38)"
1150 PRINT
1160 PRINT"%NUMBER OF PASSES ......"
     TAB(33)N1;TAB(38)"
1170 PRINT
1180 PRINT"%PERCENTAGE RECORDED ..........."
     ;P;TAB(38)"
1190 PRINT
1200 PRINT"%GRADING ................";G$;TAB(38)"
1210 PRINT
1220 PRINT
1230 PRINT" THIS IS YOUR ATTEMPT NUMBER ";G
1240 PRINT" 8888888888888888888888888888888"
     :PRINT
1250 PRINT"HAVE YOU PERMISSION FOR
     ANOTHER ATTEMPT":PRINT
1260 PRINT" ANSWER Y(YES) OR N(NO)
1270 GET K$:IF K$=" "THEN 1270
1280 IF K$="Y" THEN G=G+1:GOTO 490
1290 GOTO1000: REM*RESULTS LOOP
1300 PRINT" PRESS ANY KEY WHEN YOU ARE
     READY
1320 GET K$:IF K$=" " THEN 1320
1330 RETURN
1340 REM
1350 IF(ST)=0 OR (ST)=64 OR (ST)=-128 THEN
     1370
1360 PRINT"TAPE STATUS ERROR":STOP
1370 RETURN
1380 REM
1390 H$=LEFT$(TI$,2):M$=MID$(TI$,3,2):S$=
     RIGHT$(TI$,2)
1400 IF H$="00" THEN 1420
1410 PRINT" ";H$;" HOURS ";
1420 PRINT TAB(18) M$;" MINUTES ";S$;"
     SECONDS
1430 RETURN
1440 REM *SR CRASH--PROOF INP
1450 OPEN1,0
1460 INPUT#1,I$
1470 IF I$=" " THEN 1460
1480 CLOSE 1
1490 RETURN
```

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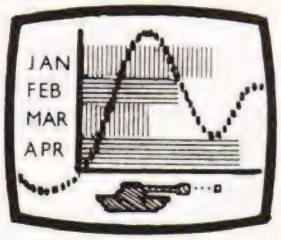

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Dear Sir,

I buy your magazine every month and consider it to be excellent value for money. Please do not forget though, that we don't all own PETs! It would be extremely helpful if you could explain the various stages of the problem so that users of other computers are able to see the necessary modifications for use on their own system. Another useful point would be a rough indication of the memory needed for the program — this could be printed at the end of the listing and would be a great help.

Having searched many issues and having found no mention of the back-number service, I came to the conclusion that you do not have such a service. Can this be?! Maybe for technical reasons you are unable to run one, I think to myself . . . other mags manage. O.K. — so we should have bought the issue when it came out; but what if we didn't?

Finally, congratulations on producing an excellent and interesting mag — I hope the above points may be of some help.

Yours faithfully,
T. Allen

24 Wood Street,
Ash Vale, Hants.

Dear Sir,

Regarding the problems which some of your readers have been having with the March/80 modem project, I have contacted the designer and obtained the following information:-

> 'The difficulty appears to be related to component tolerances in the audio filter circuits. 10K + 1K means series not parallel connection as some people have wired them. The modem board should first be tested by linking input to output directly and selecting self-test.
>
> 'Then the filters should be checked with an audio signal generator and R14,17 and 20 adjusted, for each filter stage, for peaks at f1-100 Hz, f2 + 100 Hz and ½(f1 + f2) Hz respectively. (where f1 is the low tone in use and f2 the high).'

Although the two units which were loaned to me contained component values as listed in the text they must have come from the same batch.

I am now in the process of building a pair of units to verify the above points and will contact you again in the near future. I deeply apologise for the inconvenience this has caused your staff and your readers.

Yours faithfully,
Mr R. Adams

152 Ayelands
New Ash Green, Nr Dartford
Kent, DA3 8JU

Dear Sir,

On behalf of those who enjoy your magazine but who are still getting their feet wet in the most esoteric aspects of computing (there are many), may I make a plea to those who contribute to your columns: please be explicit almost to the point of pedantry.

Being involved in preparing technical articles but in a different field, I find that what may appear laborious and perhaps unnecessary for the writer is a foothold for the reader. Much good work is unusable because terms are left undefined or sentences left ambiguous. In particular, the program NASFORTE by M.G. Foster published on pages 46 and 47 of Computing Today, April 1980, left me wondering to which Nascom (1 or 2), or both, it would apply. Being an optimist, I assumed it would apply to the Nascom 2 but then I was still left wondering from where to extract the tone output — would it be the same pin 14 of the keyboard socket? I might add that I am no longer such an optimist but perhaps someone could help.

In conclusion, such is my level of ignorance that I find myself scanning published BASIC programs for the dreaded PEEKs and POKEs or DEEKs and DOKEs. Not before the 'all clear' is established do I attempt to enter the program on my machine (16K Nascom 2). Would I be a voice crying in the wilderness for a square nought explanation of PEEK and POKE?

Yours faithfully,
C.J.T. Clarke

106a Fortune Green Road,
West Hampstead, London NW6 1DS

Dear Sir,

352 Squadron, Air Training Corps recently acquired an old but serviceable P.D.P. 8 to complement the PET already in use teaching cadets. Despite considerable help from D.E.C. we are still short of many manuals which although still available are quite expensive. If any readers have any information which could be useful to us the loan of it would be appreciated.

We are also on the lookout for any surplus computer equipment (IBM 360's etc!!), which your wife/managing director has been nagging you to get rid of for the last six months. Seriously though, if you feel that you have anything which may be of use to us (even yourself), please let us know. You would be equally welcome to come and see/lend a hand with/pinch time on the above, just give me a ring on Burnley (0282) 20009.

Yours faithfully,
G.B. Bird

85 Glen View Road,
Burnley, Lancs. BB11 5QX

Dear Sirs,

We feel we must reply to the letter regarding the inclusion of the simple password routine in our PET FINANCE program. The writers obviously have missed the point.

1. The program was written for a 'home' environment where other members of the family are only interested in LOAD & RUN commands (children with their favourite games!) and not to be used in a university where most people know a considerable amount about computers.
2. Even as it stands it acts as a deterrent to those who are not expecting it.
3. What's the use of including a security program fully — it won't be secure then.
4. Security is the elimination to as great an extent as possible of information being extracted. Locking-up data tapes is, of course, the obvious solution.
5. The inclusion was also to get a 'feel' of the readers' comments (in the home situation).
5. I do use a set of security routines in any sensitive program I have to write. It would not be worthwhile developing these routines if I were to include them in an article. Nevertheless, to help any reader thinking along these lines here are a few ideas I have used in the past, with a PET computer.

   a) Hold password and tape file name in code. Don't call the data files 'BANK DATA' give them an obscure name.
   b) Use GET commands to save echoing on the screen.
   c) Switch off the screen as the first program line.
   d) End program with NEW.
   e) End program with FORJ=1024TO8000: POKEJ,32:NEXT (system crash)
   f) All inputs as strings to avoid any break due to input error.
   g) A trick for some to find is to force the PET to accept a NULL input without breaking out of the program. The method I use for this also disables the STOP key without the POKE statements.
7. The best solution to the problem of security would surely be a password or such written into the operating system. (Mini and mainframe systems — not the PET).

Yours faithfully,
Terry Jeffery, Elaine Douse

79 Waverley Road,
Southsea, Portsmouth, Hants.

Dear Mr Harris,

I am Head of the Business Studies Department at Stromness Academy in Orkney. My Department has been fortunate enough to be chosen to take part in a Government sponsored experiment to try to assess the likely effect of micro-processors on education.

To this end we have been loaned a PET 32K, 3022 Printer, and floppy disk drive, for a period of one year in the first instance. You will appreciate that to engage in a micro-processor experiment over such a limited time period leaves me no time to become a programming expert. However, I must make the maximum use of the computer while I have it.

I purchased a copy of your magazine and was most impressed with the contents. I even managed to copy some of the simpler programs and make them work! However, the program I think would perhaps be most valuable to me for purposes of demonstration of the computer's capabilities to my general classes was written for cassette input. I refer to a program called 'Home Finance' in the March 1980 issue of 'Computing Today'.

I wonder if someone would be kind enough to help a blundering beginner at the business (pleasure?) of computing and tell me how I could alter 'Home Finance' to operate with floppy disks?

Yours sincerely,
R.C. McKenzie (Mr)

Head of Business Department
Stromness Academy
Back Road
STROMNESS Orkney

Dear Sir,

A point of contention on the Problem Page, your solution could be said to violate your statement of 'no multi-statement lines' if you count multi-bracketing.

Try this, 10 INPUT A,B,C:FOR Q=A TO B: NEXT:FOR Q=Q-1 TO C: NEXT: PRINT Q-1
Despite the fact that it is in TRS 80 Level II it should operate on the PET.

Yours,
R.J. Fox

54 Beverly Close,
Rainham, Kent.

Dear Sir,

Re: Computer Club Survey Lists

I should be grateful if you would remove my name, as the convenor of the 6800 User Group with the Mersey Micro Group, from any future publications of the above mentioned lists.

Unfortunately, due to lack of local support, it is anticipated that the user group will be folded with the next meeting.

Many thanks for your troubles,

Yours,
Eric Stancliffe,
Senior Technician

Computer Laboratory
University of Liverpool

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NASCOM TRACE

R.Russell.

Debugging of a new program is perhaps the most difficult (and therefore the most exciting and entertaining) part of programming and good debugging facilities within the monitor make this job much easier.

Although the Nascom 1 provides a flexible single step and breakpoint facility, I began to notice a number of limitations as I laboriously stepped through programs which refused to do what I wanted.

Software Requirement

Firstly, because of the scrolling action of any monitor commands, the screen display is destroyed by the single step function. It is a long-winded business therefore to step through any section of the program which uses information from the screen. This problem is a particular nuisance in games programs.

Secondly, the breakpoint function is an unconditional one, that is, the break occurs at the defined address under all circumstances. Again, particularly in games programs where loop situations are common, I found it difficult to set up the break to occur just under the conditions I wanted to test.

I decided therefore to try to overcome these problems by developing a simple Trace program. This would allow me to keep track of the flow of the program under test by displaying the contents of the program counter and also to control the speed of execution (including halting, and displaying of registers, at will).

A few hours hard reading of the relevant routines in the monitor listing revealed the basic principles used by the single step and breakpoint commands and these were duplicated in a simplified form, just providing a display of the program counter on the top line of the screen (this line not being scrolled).

Debugging the Trace program itself proved to be somewhat frustrating since, because it modifies the routines used by the monitor single step function, this function cannot easily be used to test the program. Eventually a "run it and pray" technique proved to be most successful.

Description

The program can be entered in two ways :–

a) Initially at "FIRST IN"
   The start address of the program under test is entered using the monitor routines INLINE and NEXNUM and stored in ARG 3.
b) During subsequent testing at "NEXT IN"
   The start address is taken from ARG 3 which will hold the PC value of when the program was last interrupted by the Halt key.

The start address is pushed onto the stack and the NMI jump address modified to the TRACE routine. The program then "returns" to the start address of the test program.

On receiving an NMI, the program jumps to NEW TRAP which saves the current status of the registers and displays the current PC value on the top left of the screen. A variable delay occurs followed by the NMI reset. A test is then made for a key press in the absence of which, a RETN is made to the test program.

Control keys recognised are :

H Halt. Program waits for next command which can be either :

C Continue. Program returns to test program.
D Display. Returns to monitor via breakpoint routines to display register contents. Note that scrolling occurs thus affecting screen display.

F (Faster) or S (Slower). These keys shift a value held in SPEED right or left as appropriate to control the delay period.

Points To Note

The Trace program saves the contents of the test program registers and returns them unchanged. Although the main stack is used, it is returned to the test program with the pointer at the original location.

Since the program is intimately connected with the monitor routines, care should be taken when modifying these routines. There are also some peculiarities which are best sorted out by trying the program. For instance, in some circumstances, program instructions can be executed twice.

Operation

Operation is simple. The Trace program is executed (from FIRST IN) as normal and the starting address of the program to be tested is entered, followed by NEWLINE. The test program will then run at a speed determined by keys F and S, showing the PC value on the top left of the screen. When the point to be investigated is reached, key H is pressed, halting execution. The run can then be continued (key C) or registers can be displayed (key D). After display, the normal monitor commands are available, including single step, from the current PC. Continuing the run under Trace after display is accomplished by executing from NEXT IN.

Program Listing

TRACE

Address	Opcode	Label	Mnemonic	Comment
0F30	CD DB 01	FIRST IN	CALL INLINE	Enter start
3	11 4B 0B		LD DE 0B4B	address of test
6	CD 5A 02		CALL NEXNUM	program.
9	7E B7		LD A(HL) CPA 00	
B	28 F3	NO ARG.	Jump if 0 FIRST IN	
D	23		INC HL	
E	01 10 0C	STORE ARG.	LD BC ARG 3	Store start
41	7E 02		LD A(HL) LD (BC)A	address
3	23 03		INC HL, BC	
5	7E 02		LD A(HL) LD (BC)A	
0F47	E5	NEXT IN	PUSH HL Dummy	Reserve return
8	F5 E5		PUSH AF, HL	Save registers
A	2A 10 0C		LD HL ARG 3	Push execute
D	33 33 33 33 33 33		INC SP x 6	address onto
53	E5		PUSH HL	stack and
4	3B 3B 3B 3B		DEC SP x 4	adjust SP
8	21 65 0F		LD HL NEW TRAP	Relocate NMI
B	22 48 0C E1		LD (0C48) HL POP HL	routine
F	3E 08 D3 00		LD A 08 OUT 0 A	Set NMI
63	F1 C9		POP AF RET	Jump to Prog

```
0F65  E3 22 3B 0C  NEW TRAP   EX (SP)HL LD (0C3B)HL  Save
   9  E3                      EX (SP)HL               registers
   A  F5 E5 C5               PUSH AF, HL, BC
   D  21 CD 0B               LD HL 0BCD              Relocate cursor
  70  22 18 0C               LD (0C18) HL            location
   3  21 3C 0C               LD HL RPC + 1           Display
   6  06 02                  LD B 02                 current
   8  7E             DISPLAY LD A (HL)               PC
   9  CD 44 02               CALL B2HEX
   C  2B                     DEC HL
   D  10 F9                  DJNZ DISPLAY
   F  21 C7 0F               LD HL SPEED             Delay
  82  46                     LD B (HL)
   3  CD 35 00       DELAY   CALL KDEL
   6  10 FB                  DJNZ DELAY
   8  D3 00          RESET NMI OUT 0 A               Reset NMI
0F8A  CD 69 00       KEY PRESS? CALL KBD             Test for key
   D  38 09                  Jump if C HALT?         pressed
   F  C1 E1          NOKEY   POP BC, HL
  91  3E 08 D3 00    SET NMI LD A 08 OUT 0 A         Set NMI and
   5  F1 ED 45               POP AF RETN             return to Prog
   8  FE 48          HALT?   CP A 'H'
   A  20 1A                  Jump non 0 FASTER?
   C  CD 3E 00       HALT    CALL CHIN               Halt
   F  FE 43                  CP A 'C'
  A1  28 EC                  Jump if 0 NO KEY        Continue
   3  FE 44                  CP A 'D'
   5  20 F5                  Jump non 0 HALT
   7  2A 3B 0C       DISPLAY LD HL (RPC)             Store current PC
   A  22 10 0C       REGS.   LD (ARG 3) HL
   D  C1 E1                  POP BC, HL
   F  CD 40 02               CALL CRLF               Reset cursor location
  B2  F1                     POP AF
   3  C3 20 00               Jump BREAKPOINT         Jump to Breakpoint
0FB6  FE 46          FASTER? CP A 'F'
   8  20 04                  Jump non 0 SLOWER?
   A  CB 3E                  SRL (HL)                Decrease delay constant
   C  18 D1                  Jump NOKEY
   E  FE 53          SLOWER? CP A 'S'
  C0  20 C8                  Jump non 0 KEY PRESS?
   2  37 CB 16               SET C RL (HL)           Increase delay constant
   5  18 C8                  Jump NOKEY
0FC7  SPEED FF
```

The Nascom Trace Program.

SKI RUN

Christopher Hales.

Ski run is an interactive graphics game for the UK101, written in BASIC it should be easily adaptable to other machines. The VDU screen is dotted with numerous trees and the player moves a skier from the top left to the bottom right of the screen towards his 'house'. The screen represents a snowy slope and so if the player does not press any buttons the skier will move downwards. The player has two keys, the 'Q' and 'P' keys, which will move the skier left or right – but whenever no key is pressed the skier will move down the screen. The player has to manoeuvre the skier through the gaps in the trees to the character space occupied by his house in the lower right corner. If the skier hits a tree he has an accident of course, so you must start again. Before the run starts the player chooses the speed the skier moves at – from 5 (very low) to 0 (very fast), with any value in between being available (i.e. not just integer values). If the skier goes off the bottom of the screen he reappears the same distance across at the top of the screen and then makes his second 'run'. When the skier reaches the space occupied by the house a flag goes up on the house and the number of runs and the speed is given.

Game Implementation

This version works for a portable TV screen which gave a width of 47 characters and a depth of 16 lines. The RAM values given with the POKE function refer to the following screen positions:
(NB 54278 comes after the last line on the screen and is used to check if the skier goes off the bottom)
The ASCII characters used are :

4	an explosion type character
13	tree (but on my computer this was not accessible by the CHR$ function)
15	house
32	space
143,151	a horizontal rectangle and vertical line to give a flag
240	a man

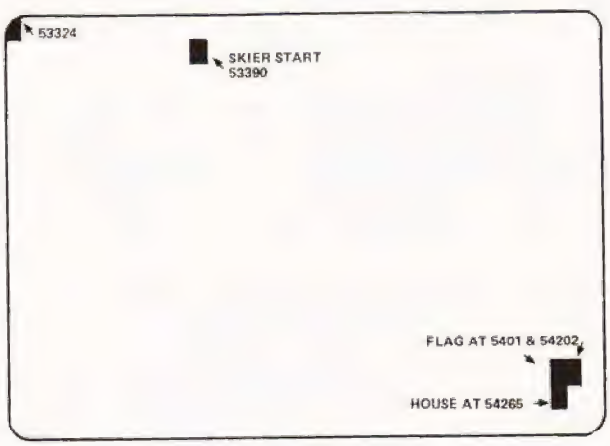
Here are some other notes on the UK 101 BASIC :
POKE 530,1 and POKE 530,0 disable and enable the 'control C' key so that it will not intrude on a region, enabling control of the keyboard to be obtained.
POKE 57088,RA and IF PEEK (57088)=CA THEN . . . are used to alter key functions given the row address (RA) and column address of the keys involved. The polling routine will respond to only one key being down at any time, given the same row address.
RND(X) for any argument always returns a random number between 0 and 1, spaces are not necessary.

The best result yet seen is a success at level 0.15 in 1 run (after hours of trying). This is a suggested classification of the levels :

5 EASY
4 QUITE EASY
3 AVERAGE
2 QUITE HARD
1 HARD
0 ALMOST IMPOSSIBLE

But of course you can have any intermediate level.

Possible modifications are : to have only 1 key, moving right; to alter the range of speeds; to allow only 1 run.



Screen positions for graphics. You may adjust to suit your system map.

Program Explanation

LINES

10 – 40	INSTRUCTIONS AND SKIING SPEED INPUTS
50	CLEARS SCREEN
60 – 90	PUTS TREE CHARACTERS ON 125 RANDOM SCREEN CHARACTER SLOTS

100 – 120 PUTS SKIER IN TOP LEFT CORNER AND CLEARS THE SPACE UNDER HIM, PUTS HOUSE IN LOWER RIGHT CORNER, INITIALISES RUNS VARIABLE TO 1
130 SLIGHT DELAY BEFORE SKIER MOVES
140 DISABLES 'CONTROL C' – NECESSARY FOR DISABLING POLLED KEYBOARD
150 – 190 STORES PREVIOUS SKIER POSITION : DISABLES NORMAL KEYBOARD POLLING ROUTINE AND TESTS FOR P OR Q KEYS BEING PRESSED. CHANGES SKIERS SCREEN REFERENCE
200 – 210 GOES TO ROUTINES FOR IF SKIER HITS A TREE OR REACHES HOUSE
220 MOVES SKIER
230 GIVES THE DELAY WHICH ALTERS SPEED
240 IF SKIER GOES OFF SCREEN AT BOTTOM, GOES TO ROUTINE TO PUT HIM BACK
300 – 340 SKIER HITS TREE : PUTS UP A CRASH CHARACTER, GIVES RELEVANT COMMENTS
400 – 460 SKIER REACHES HOME : PUTS A FLAG ABOVE HOUSE, GIVES RELEVANT COMMENTS
470 – 480 ASKS FOR ANOTHER GAME
490 ENABLES 'CONTROL C', END
500 – 530 IF SKIER GOES OFF BOTTOM, RETURNS HIM DIRECTLY ABOVE ON TOP LINE OF SCREEN, REMOVING A TREE IF THIS PUTS HIM ON ONE
600 – 750 INSTRUCTIONS
760 ENDS

Program Listing

```
10  INPUT "DO YOU NEED INSTRUCTIONS";I$
20  IF LEFT$(I$,1)="Y" THEN 610
30  INPUT "WHAT IS YOUR SKIING SPEED (0–5)";K
40  IF K<0 OR K>5 THEN 30
50  FOR LINE=1 TO 16:PRINT:NEXT
60  FOR TREE=1 TO 125
70  P=53324+INT(50*RND(1))+64*INT(17*RND(1))
80  POKE P,13
90  NEXT
100 R=53390:J=1
110 POKER,240:POKER+64,32
120 POKE 54265,15
130 FOR T=1 TO 700:NEXT
140 POKE 530,1
150 PRE=R
160 POKE 57088,253:M=PEEK(57088)
170 IF M=127 THEN R=R–1:GOTO 200
180 IF M=253 THEN R=R+1:GOTO 200
190 R=R+64
200 IF PEEK(R)=13 THEN 310
210 IF PEEK(R)=15 THEN 410
220 POKEPRE,32:POKER,240
230 FOR Y=1 TO K*100:NEXT
240 IF R>54278 THEN POKER,32:GOTO 510
250 GOTO 150
300 REM CRASH ROUTINE
310 POKEPRE,32:POKER,4
320 PRINT "YOU HAVE JUST HAD AN ACCIDENT. ."
330 PRINT "WHEN YOU RECOVER WOULD YOU LIKE"
340 GOTO 470
400 REM WIN ROUTINE
410 POKEPRE,32
420 POKE 54201,143:POKE 54202,151
430 PRINT "WELL DONE. . .YOU JUST MADE IT IN"
440 PRINT "TIME FOR YOUR TEA!!"
450 PRINT "IT TOOK YOU "J" RUNS DOWN THE SLOPE"
460 PRINT "AND YOUR SPEED LEVEL WAS"K
470 INPUT "ANOTHER GAME. . . . . ";A$
480 IF LEFT$(A$,1)<>"N" THEN 30
490 POKE 530,0:END
500 REM NEW RUN
510 R=R–960:J=J+1
520 IF PEEK(R)=13 THEN POKER,32
530 GOTO 220
600 REM INSTRUCTIONS
610 PRINT "          ** SKI RUN **":PRINT
620 PRINT "YOU ARE AT THE TOP OF A SNOWY HILL"
630 PRINT "WHICH IS DOTTED WITH TREES"
640 PRINT "YOU START AT THE TOP LEFT CORNER OF"
650 PRINT "THE SCREEN AND YOU'VE TO GET TO"
660 PRINT "YOUR HOME AT THE BOTTOM RIGHT"
670 PRINT
680 PRINT "TO GO LEFT PRESS THE 'Q' KEY"
690 PRINT "TO GO RIGHT PRESS THE 'P' KEY"
700 PRINT
710 PRINT "IF NO KEY IS PRESSED YOU WILL MOVE"
720 PRINT "VERTICALLY DOWNWARDS. . . . ."
730 PRINT "PRESS ONLY 1 KEY AT ANY TIME"
740 INPUT "PRESS 'Y' AND RETURN TO CONTINUE"; B$
750 IF LEFT$(B$,1)="Y" THEN 30
760 GOTO 490
```

Program listing for Ski Run in UK101 Basic.

DECIMAL POINT

Paul Evans

Here is a little one line idea that will print out decimal numbers around a decimal point. This allows numbers to be neatly aligned for tabular printing, even if the decimal point is not used. In general the following can be used :–

PRINT TAB (D–INT(LOG(X)*0.4343+1));X

but on some machines you will need to use –1 instead of +1.

D is the value of the decimal point position, even if no actual point is to be printed, X is the variable to be printed.

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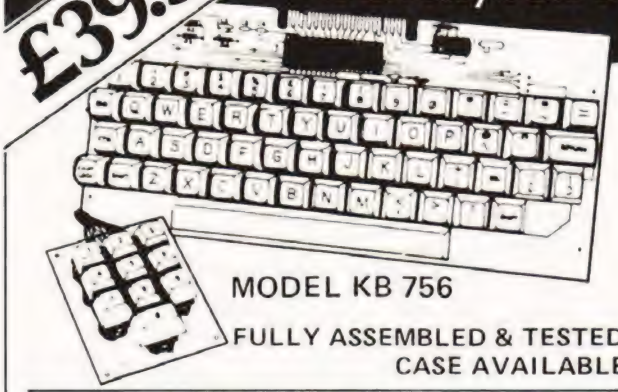

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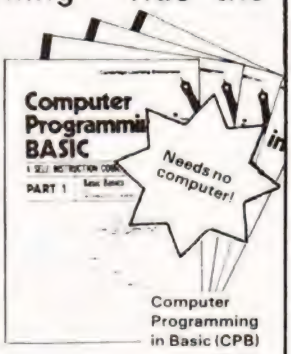

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UART PROJECT

R. Adams

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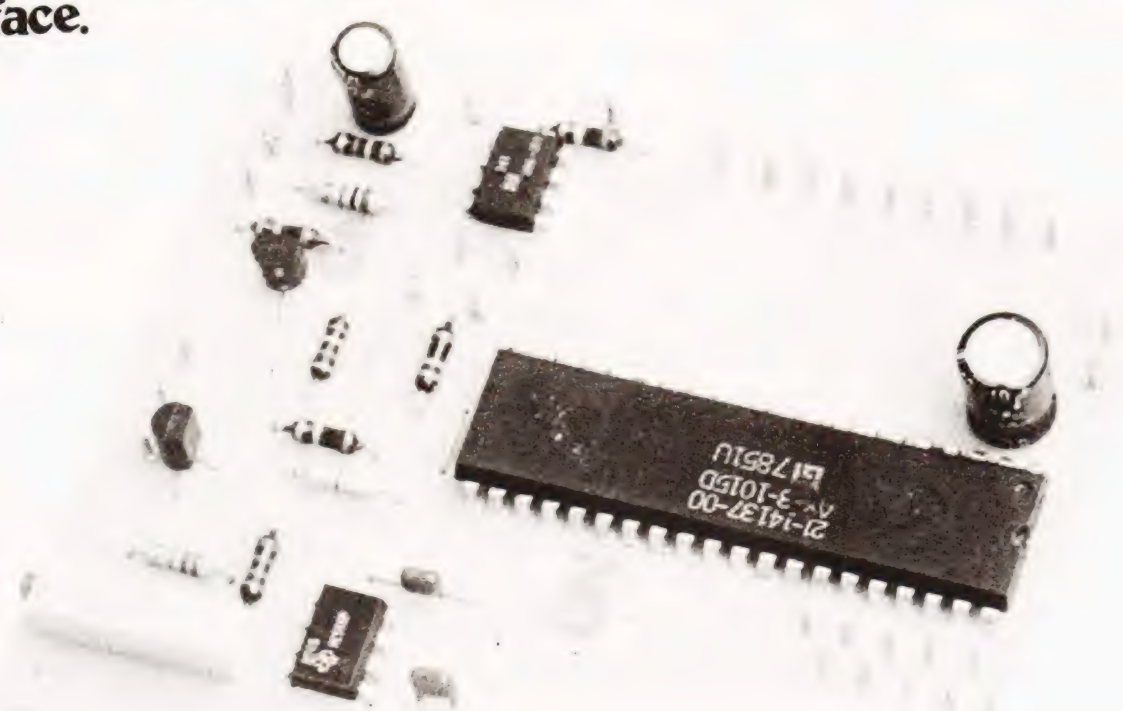


Following on from the Modem Project (CT Mar. '80), which, incidentally, a number of people have said makes a good cassette tape interface, I wanted to return my borrowed ASR33 TTY machine and use a quiet printer and home-made keyboard.

My printer and keyboard both speak in 8-bit, 5 V logic words so this board was produced to provide a serial I/O channel. The block diagram, Fig.1, shows that a single UART chip performs the required Parallel to Serial and Serial to Parallel conversions, with serial data swings of 5 V/0 V or +12/−12.

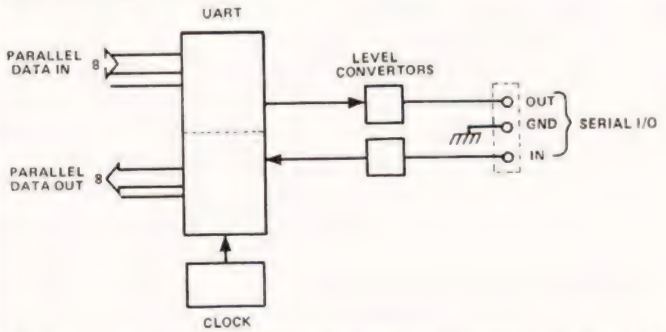


Fig 1. Block diagram showing the necessary elements for the UART interface unit.

Clocking It

Another IC is used to clock the UART and thus determine the Baud rate of the serial signals. Component values are given for the common 110, 300 and 600 rates only (although the UART will work up to about 30 KBd.). This restriction was purely to match the 600 maximum of my Modem and printer. If you can get hold of a CMOS 555 for IC3 then do so as they are more stable than the bipolar version.

The circuit is shown in Fig.2 and requires little explanation. If you are only interested in 5 volt levels then omit Q1 and IC2, conversely, for an RS232 type output, + and −12volt supplies are necessary.

To keep things simple, the UART control pins are permanently wired for a serial format of; 1 start bit, 8 data bits, 2 stop bits. For variations on this please refer to the 1015 data sheet, (usually available on request with the IC), and choose links LK1-LK5 as required.

Component values in the table for the clock are for 110 Baud. For 300 or 600 use the bracketed values of R9 and R10. i.e. 110(300)(600).

Setting up requires that the clock be adjusted to a frequency of 1760 Hz (or 4800/9600). This should be done with the aid of a counter but a fairly accurate result can be achieved by using an oscilloscope.

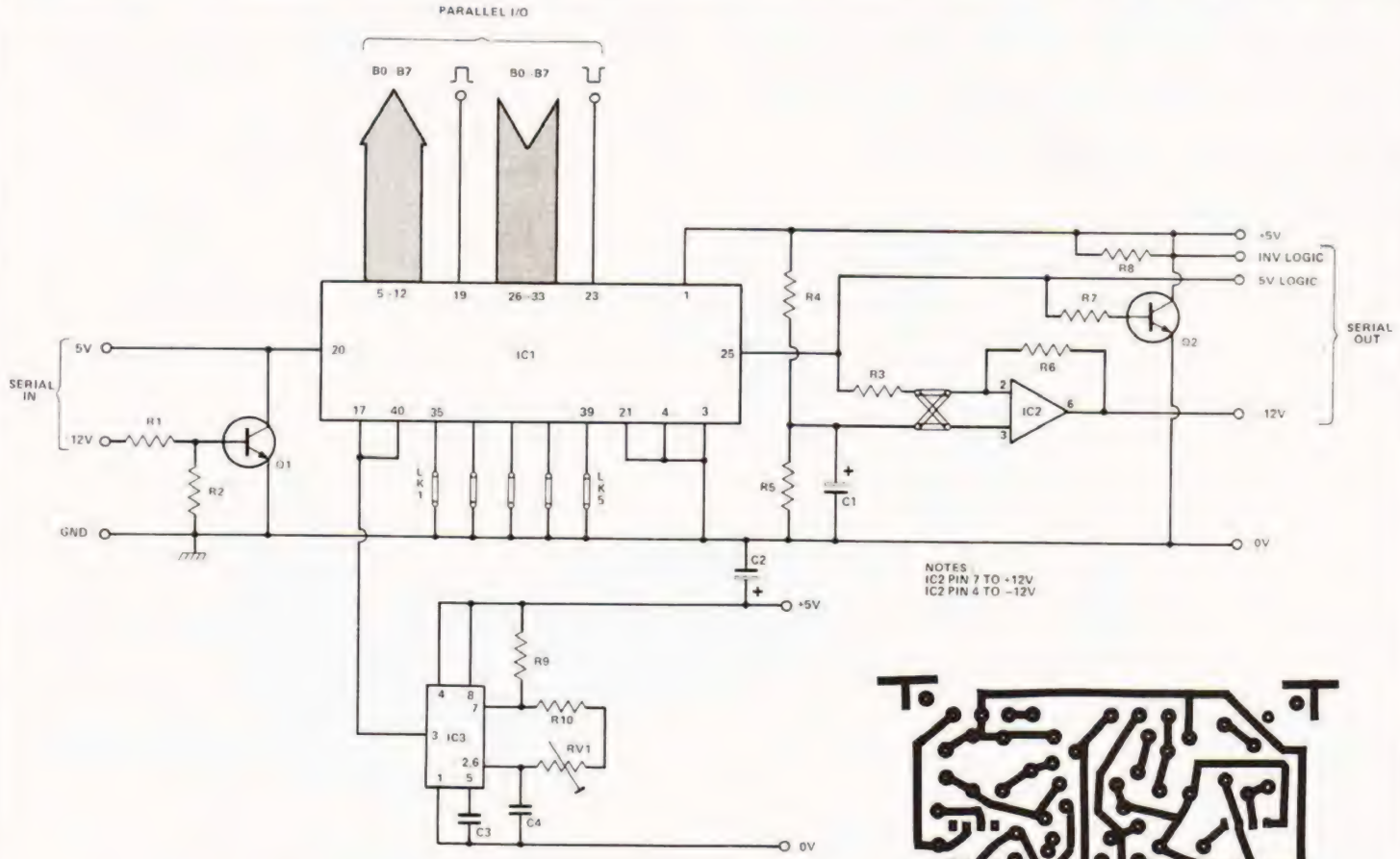


Fig 2. Above: the circuit diagram, see text for component changes where marked *.

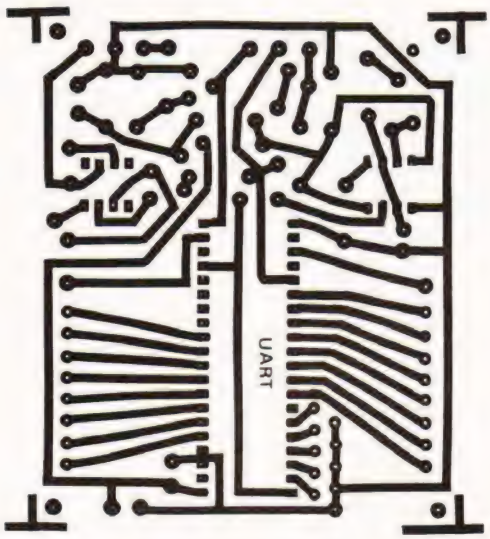
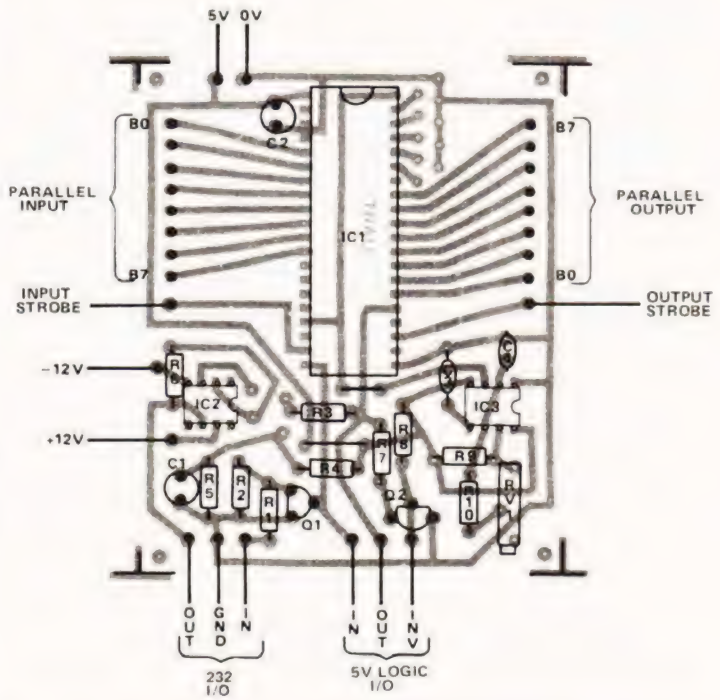


Fig 3. Right: the foil pattern for the board, links 1-5 may be altered to suit your needs.

Fig 4. Below: the overlay for the UART board showing interconnections.



PARTS LIST

RESISTORS all ¼W, 5%

R1,3	10k
R2	1k0
R4,5	1k8
R6,7	100k
R8	4k7
R9	3k9 (2k2)(1k0)
R10	47k (12k)(6k8)
R11	10k 10 turn horiz preset

CAPACITORS

C1	22u 16V electrolytic
C2	10u 63V electrolytic
C3,4	10n ceramic

SEMICONDUCTORS

IC1	AY-3-1015
IC2	741
IC3	555 (preferably CMOS type)
Q1,2	BC184 or similar NPN

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T. Lusty

In this month's offering we present iteration, quite a repetetive process at the best of times!

Consider the game of golf. You have an aim; ie. to set the ball into the hole. You have a process; ie. you hit the ball with the club. You repeat the process of hitting the ball with the club, until you set the ball into the hole, or you lose it. Golf is therefore an iterative process, your first attempt is unlikely to be right, (there are few holes in one!) but your second shot should be nearer the hole than your first. Your third should be closer still, and so you progress towards your goal.

Iterative Techniques

To the mathematician an iterative technique is the process of repeatedly using a mathematical formula to improve an approximate solution to a mathematical problem. The steps are as follows: -

1) Make a guess at the possible answer.
2) Find some method which you hope will improve your answer.
3) Make the answer from step 2 your next guess and use the process again to improve these results.
4) Continue steps 2 and 3 until your answer cannot be improved further.
5) Check whether or not the answer you have found is reasonable.

Find The Numbers

Now for our problem. We can write down six simple equations: -

1) A + B - X = 0
2) B + C - Y = 0
3) D + Z - C = 0
4) D + E - B = 0
5) E + Z - A = 0
6) A + C - F = 0

where for our problem X = 18, Y = -8 and Z = 14.

This set of simultaneous equations may be solved by a number of methods, and these can be found in any good book on Numerical Analysis. We shall try to work out a simple iterative trial and error method.

Let's start by guessing that all the values A to F are zero, which gives the starting position shown in figure 1.

Now our first equation is clearly not correct, A + B - X = -18 and not zero as required. However, we can try to set nearer to the real values by distributing this error to A and B. We let A = 9 and B = 9, and equation 1 is now correct.

We now move to equation 2, remembering that B is 9 and not zero. B + C − Y = 17 and not zero so 8.5 is subtracted from B and C. We now move on to the other equations: -

A	B	C	D	E	F	Equation
9	.5	-8.5	0	0	0	D+Z-C=22.5
9	.5	2.8	-11.3	0	0	D+E-B=-11.75
9	-3.4	2.8	-7.3	3.9	0	E+Z-A=8.9
13.5	-3.4	2.8	-7.3	-.5	0	A+C-F=16.3
8.1	-3.4	-2.7	-7.3	-.5	5.4	

This means that after one pass through our iterative procedure the problem and guesses are as shown in figure 2. Note that this is not best iterative procedure,

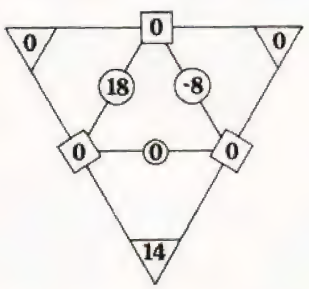

Fig 1. The first guess.

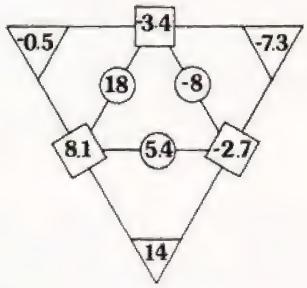

Fig 2. After one iteration

but I have tried to be consistent so that the method is easy to understand. The discrepancy is shared equally between all the variables in the given equation, which means that it is divided by three for equations 4 and 6, and by two for the remainder.

The Program

The program for the above method is given in figure 3.

```
1200 READ X,Y,Z
1200 DATA 18,-8,14
1220 REM ***MAKE INITIAL GUESS***
1240 LET A=0:B=0:C=0:D=0:E=0:S=0
1260 PRINT "-A- -B- -C- -D- -E- -F-"
1280 PRINT
1300 REM ***EQUATION ONE***
1320 LET P=(A+B-X)/2
1340 LET A=A-P
1360 LET B=B-P
1380 REM ***EQUATION TWO***
1400 LET P=(B+C-Y)/2
1420 LET B+B-P
1440 LET C=C-P
1460 REM ***EQUATION THREE***
1480 LET P=(D+Z-C)/2
1500 LET D=D-P
1520 LET C=C+P
1540 REM ***EQUATION FOUR***
1560 LET P=(D+E-B)/3
1580 LET D=D-P
1600 LET E=E-P
1620 LET B=B+P
1640 REM ***EQUATION FIVE***
1660 LET P=(E+Z-A)/2
1680 LET E=E-P
1700 LET A=A+P
1720 REM ***EQUATION SIX***
1740 LET P=(A+C-F)/3
```

```
1760 LET A=A-P
1780 LET C=C-P
1800 LET F=F+P
1820 GOSUB 1920
1840 REM ***HAVE WE FINISHED***
1860 IF ABS(F-S) (.0001 THEN END
1880 LET S=F
1900 GOTO 1320
1920 REM ***ROUNDING AND PRINTING***
1940 LET A1=INT(1000*A+.5)/1000
1960 LET B1=INT(1000*B+.5)/1000
1980 LET C1=INT(1000*C+.5)/1000
2000 LET D1=INT(1000*D+.5)/1000
2020 LET E1=INT(1000*E+.5)/1000
2040 LET F1=INT(1000*F+.5)/1000
2060 PRINT A1;B1;C1;D1;E1;F1
2080 RETURN
```

Fig 3. The 'Find The Number' Program, in PET BASIC.

-A-	-B-	-C-	-D-	-E-	-F-
+ 8.056	- 3.417	- 2.653	- 7.333	- .542	+ 5.403
+12.764	- 5.590	- 3.753	- 9.597	+ 2.372	+ 9.010
+15.874	- 5.582	- 3.778	-11.323	+ 4.959	+12.096
+18.123	- 5.388	- 3.601	-12.761	+ 6.550	+14.523
+19.747	- 5.399	- 3.408	-13.770	+ 7.564	+16.339
+20.906	- 5.482	- 3.206	-14.445	+ 8.268	+17.701
+21.736	- 5.565	- 3.005	-14.904	+ 8.766	+18.731
+22.335	- 5.640	- 2.823	-15.224	+ 9.117	+19.513
+22.771	- 5.706	- 2.664	-15.447	+ 9.364	+20.106
+23.088	- 5.763	- 2.531	-15.604	+ 9.539	+20.557
+23.322	- 5.811	- 2.421	-15.714	+ 9.664	+20.900
+23.493	- 5.851	- 2.332	-15.793	+ 9.754	+21.161
+23.621	- 5.882	- 2.260	-15.849	+ 9.819	+21.360
+23.715	- 5.908	- 2.203	-15.889	+ 9.867	+21.512
+23.785	- 5.928	- 2.158	-15.919	+ 9.901	+21.627
+23.838	- 5.944	- 2.123	-15.940	+ 9.926	+21.715
+23.878	- 5.957	- 2.095	-15.955	+ 9.945	+21.783
+23.907	- 5.966	- 2.074	-15.967	+ 9.959	+21.834
+23.930	- 5.974	- 2.057	-15.975	+ 9.969	+21.873
+23.947	- 5.980	- 2.044	-15.981	+ 9.977	+21.903
+23.960	- 5.985	- 2.034	-15.986	+ 9.982	+21.926
+23.969	- 5.988	- 2.026	-15.989	+ 9.987	+21.943
+23.977	- 5.991	- 2.020	-15.992	+ 9.990	+21.957
+23.982	- 5.993	- 2.015	-15.994	+ 9.992	+21.967
+23.986	- 5.995	- 2.012	-15.995	+ 9.994	+21.975
+23.990	- 5.996	- 2.009	-15.997	+ 9.996	+21.981
+23.992	- 5.997	- 2.007	-15.997	+ 9.997	+21.985
+23.994	- 5.998	- 2.005	-15.998	+ 9.997	+21.989
+23.995	- 5.998	- 2.004	-15.998	+ 9.998	+21.991
+23.996	- 5.999	- 2.003	-15.999	+ 9.999	+21.993
+23.997	- 5.999	- 2.002	-15.999	+ 9.999	+21.995
+23.998	- 5.999	- 2.002	-15.999	+ 9.999	+21.996
+23.998	- 5.999	- 2.001	-15.999	+ 9.999	+21.997
+23.999	- 6.000	- 2.001	-16.000	+ 9.999	+21.998
+23.999	- 6.000	- 2.001	-16.000	+10.000	+21.998
+23.999	- 6.000	- 2.001	-16.000	+10.000	+21.999
+23.999	- 6.000	- 2.000	-16.000	+10.000	+21.999
+24.000	- 6.000	- 2.000	-16.000	+10.000	+21.999
+24.000	- 6.000	- 2.000	-16.000	+10.000	+21.999
+24.000	- 6.000	- 2.000	-16.000	+10.000	+22.000
+24.000	- 6.000	- 2.000	-16.000	+10.000	+22.000
+24.000	- 6.000	- 2.000	-16.000	+10.000	+22.000

Fig 4. The chart produced by the program in Fig 3, the last line is the solution.

A final point is that not all iterative procedures converge, in the same way that you can lose the ball when playing golf you can find your answers moving away from rather than towards the solution. This phenomenon is known as divergence and is the reason for step 5 of the algorithm above. Just like the little girl, when they are good they are very very good, but when they are bad they are awful!

First Home

This month's problem is a little different. Figure 5 shows the run of a game called 'First Home'. The problem comes in three parts: -

1) Find a winning strategy for the game.
2) How can you best disguise your strategy so that it is not immediately obvious to someone listing your program?
3) Write a program to play the game.

```
THIS IS THE GAME OF 'FIRST HOME'
DO YOU WANT INSTRUCTIONS? YES
THIS IS A GAME BASED ON A 10 BY 10 BOARD
NUMBERED IN THE FOLLOWING WAY: -

 0  1  2  3  4  5  6  7  8  9
10 11 12 13 14 15 16 17 18 19
20 21 22 23 24 25 26 27 28 29
30 31 32 33 34 35 36 37 38 39
40 41 42 43 44 45 46 47 48 49
50 51 52 53 54 55 56 57 58 59
60 61 62 63 64 65 66 67 68 69
70 71 72 73 74 75 76 77 78 79
80 81 82 83 84 85 86 87 88 89
90 91 92 93 94 95 96 97 98 99

THE FIRST PLAYER BEGINS BY PLACING A PEG IN
ANY SQUARE ON THE BOTTOM ROW, AND THE
OBJECT OF THE GAME IS TO MOVE IT 'HOME' TO
SQUARE ZERO.

WE TAKE TURNS AT MOVING THE PEG, AND THE
WINNER IS THE PLAYER WHO MAKES THE FINAL
JUMP. YOU MAY MOVE THE PEG HORIZONTALLY,
VERTICALLY OR DIAGONALLY BY AS MANY
SQUARES AS YOU WISH, BUT ONLY MOVES
TOWARDS ZERO ARE PERMITTED.

YOU MAY CONCEDE THE GAME AT ANY POINT
BY
ENTERING A NEGATIVE NUMBER.

DO YOU WANT TO START? YES

OK - YOU START - WHERE DO YOU WISH TO
PLACE THE PEG? 97

I SHALL MOVE THE PEG TO SQUARE 47

 0  1  2  3  4  5  6  7
10 11 12 13 14 15 16 17
20 21 22 23 24 25 26 27
30 31 32 33 34 35 36 37
40 41 42 43 44 45 46 47

TO WHICH SQUARE DO YOU WISH TO MOVE? 21

I'M SORRY - YOU CAN'T MOVE THERE I HOPE
YOU'RE NOT TRYING TO CHEAT!!!

 0  1  2  3  4  5  6  7
10 11 12 13 14 15 16 17
20 21 22 23 24 25 26 27
30 31 32 33 34 35 36 37
40 41 42 43 44 45 46 47

TO WHICH SQUARE DO YOU WISH TO MOVE? 27

I SHALL MOVE THE PEG TO SQUARE 21

 0  1
10 11
20 21

TO WHICH SQUARE DO YOU WISH TO MOVE? -1

I'M SORRY YOU GAVE UP - I WIN BY DEFAULT -
DO YOU WANT ANOTHER GAME? NO

THANKS FOR THE GAME - BYE BYE FOR NOW
```

Fig 5. A sample run of the 'First Home' game.

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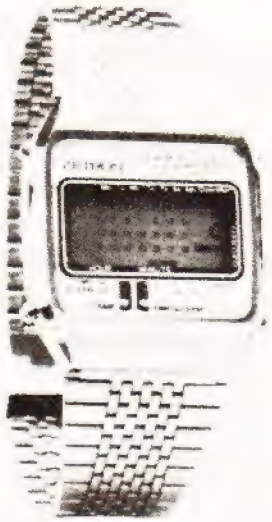

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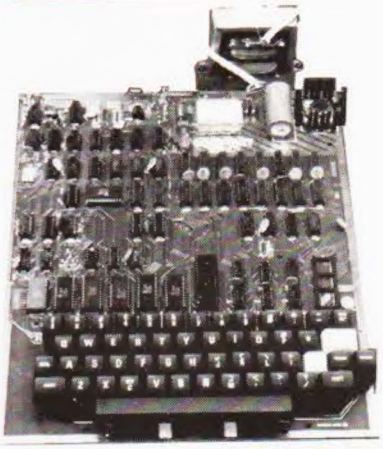

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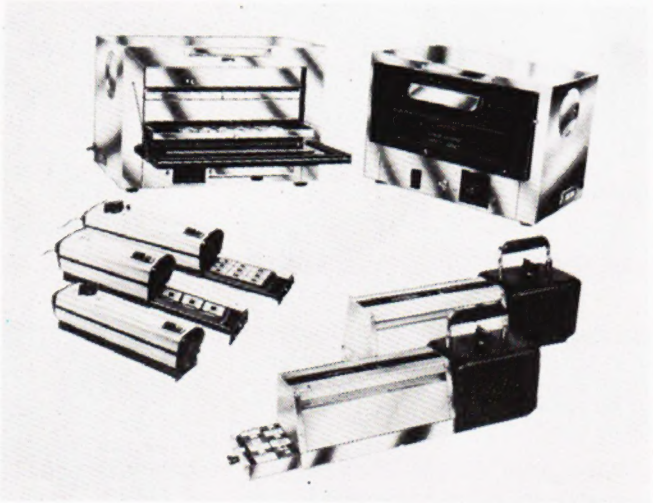

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